Appendix A Annotated Bibliography

REPORT
JULY 2024

Old Colony Planning Council Regional Water Plan: Annotated Bibliography

Prepared for:

Old Colony Planning Council

Contents

Figures

Tables

Acronyms and Abbreviations

ADD	Average daily demand
ARJWW	Abington Rockland Joint Water Works
ASR	Annual Statistics Report
BWS	Brockton Water Supply
cfs	Cubic feet per second
CSO	Combined sewer overflow
CWMP	Comprehensive Water Master Plan
DCR	Department of Conservation and Recreation
DEP	Massachusetts Department of Environmental Protection
EPA	U.S. Environmental Protection Agency
GAC	Granular activated carbon
gpm	Gallons per minute
MAPC	Metropolitan Area Planning Council
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum contaminant level
MDD	Maximum daily demand
MG	Million gallons
mg/L	Milligrams per liter
MGD	Million gallons per day
MVP	Municipal Vulnerability Plan
MWRA	Massachusetts Water Resource Authority
ND	Not detected
OCPC	Old Colony Planning Council
ORSG	Office of Research and Standards Guideline
PFAS	Per- and poly-fluoroalkyl substances
PFAS6	Set of six per- and poly-fluoroalkyl substances currently used in MassDEP regulation including PFOA, PFOS, GenX, PFBS, PFNA, PFHxS
PFBS	Perfluorobutane sulfonate
PFDA	Perfluorodecanoic acid

PFHpA	Perfluoroheptanoic acid
PFHxS	Perfluorohexane sulfonate
PFNA	Perfluorononanoic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonic acid
ppb	Parts per billion
ppm	Parts per million
ppt	Parts per trillion
RGPCD	Residential gallons per capita day
SSO	Sanitary sewer overflow
SMCL	Secondary maximum contaminant levels
SWMI	Sustainable Water Management Initiative
TMDL	Total maximum daily load
TOC	Threshold odor number
UAW	Unaccounted for water
UMDI	University of Massachusetts Donahue Institute
UNK	Unknown
USGS	United States Geological Survey
WMA	Water Management Act
WMP	Water Management Permit
WSCA	Water Supply Continuation Agreement
WTP	Water treatment plant
%	Percent

1.0 Introduction

The Old Colony Regional Water Plan is a stakeholder-driven regional water plan currently in development that includes the communities of Abington, Avon, Bridgewater, Brockton, Duxbury, East Bridgewater, Easton, Halifax, Hanover, Hanson, Kingston, Pembroke, Plymouth, Plympton, Stoughton, West Bridgewater, and Whitman, Massachusetts, as well as the Taunton River and South Coastal Watersheds.

This annotated bibliography documents CDM Smith's current understanding of the region and the specific communities' water systems. This document uses data that have been received from the watersheds, communities, or is publicly available. For communities, the requested data included:

- Information from their water departments:
  - Permits and registrations
  - Facilities' information
  - Population and demand information
  - Existing plans and previous studies
- Information from their towns:
  - Municipal Vulnerability Plans
  - Open Space Plans
  - Master Plans

This annotated bibliography summarizes the reports that were reviewed, focusing specifically on what is relevant to the development of this Regional Water Plan. **Section 1** includes regional information, including community data, information on the watersheds included in this plan, and the Water Management Act. **Sections 2** through **18** correspond to the 17 communities supported by this plan. Each of these sections include standard subsections, following the format listed in **Table 1.1**. Plympton does not include all of the subsections, as it does not have a public water supply.

Table 1.1 Standard Subsections Used for Each Community

Number	Subsection Name	Description
1	Water Supply	This section includes details related to permits and registrations, water treatment facilities, water storage facilities, water distribution system, interconnections, and private wells.
2	Water Demand	This section includes historical demand, typically from 2022, and any future projections, if this was available.
3	Issues and Concerns	This section summarized water supply issues related to infrastructure or water quality and demand issues, such as high percentages of unaccounted for water.
4	Water Supply Alternatives	This section discusses any alternatives related to water supplies or demand management that is currently being done or will be pursued in the future.
5	Questions	This section asks any remaining questions from CDM Smith's review of the materials provided. The goal is for steering committee members to coordinate with other staff members to provide answers to these questions to support the development of the Regional Water Plan.
6	References	This section lists the references cited in each section. These documents are stored in a file library within CDM Smith's files for easy access as technical work progresses.

Water supply information is provided in detail for each community. Registrations and Water Management Permits provide the maximum amount of water that a community can withdraw daily on an annual average. Communities with groundwater wells are also issued a maximum daily rate allowed to be withdrew from each well. These maximum values by well differ from the annual averages. More details are provided in **Section 2.3** on the Water Management Act. Any Water Management Act permit violations, Maximum Contaminant Level (MCL), or Secondary Maximum Contaminant Levels (SMCL) exceedances are noted in red text throughout the document.

2.0 Regional Information

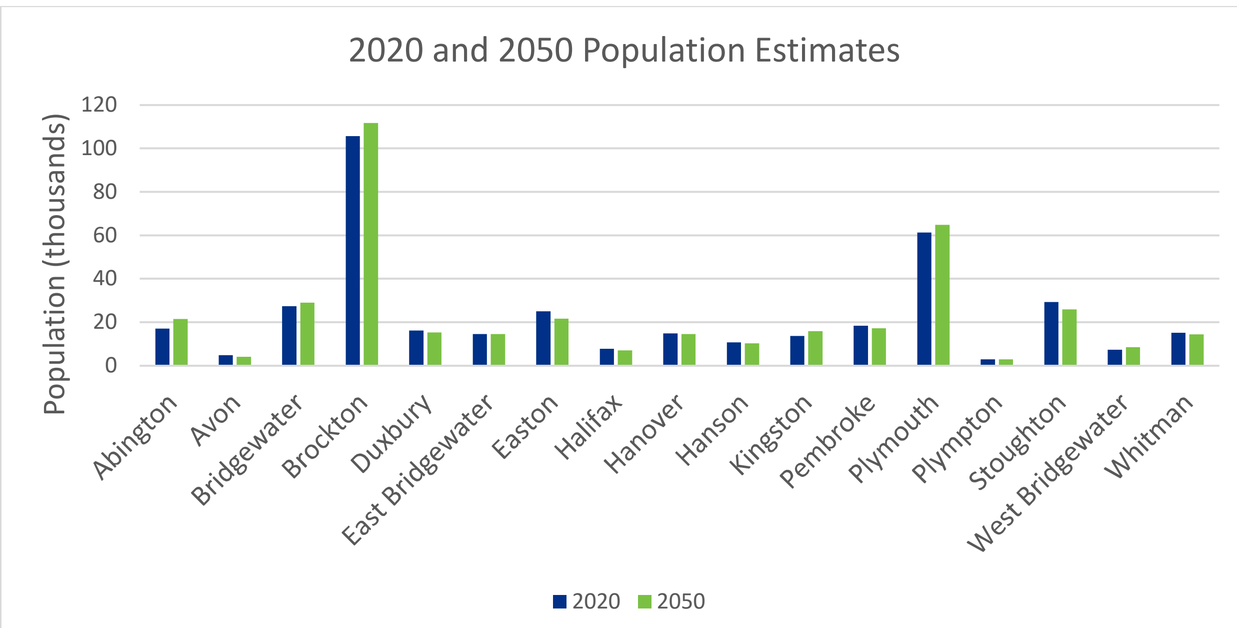
This section provides data for the region, provided per community. It also includes information on the watersheds in this region, including the South Coastal Basin and the Taunton River Watershed.

2.1 Community Data

Relevant data for the communities are included in this section to understand the region that the Old Colony Planning Council Regional Water Plan will serve. These data include population data, income data, and environmental justice block group data.

2.1.1 Population of Old Colony Planning Council Communities

Figure 2.1 summarizes the population per community that this plan will serve. The total population estimate for this region is approximately 391,296 according to 2020 Census data (United States Census Bureau 2021a). Future projections for population are based off analysis conducted by the University of Massachusetts Donahue Institute (UMDI).

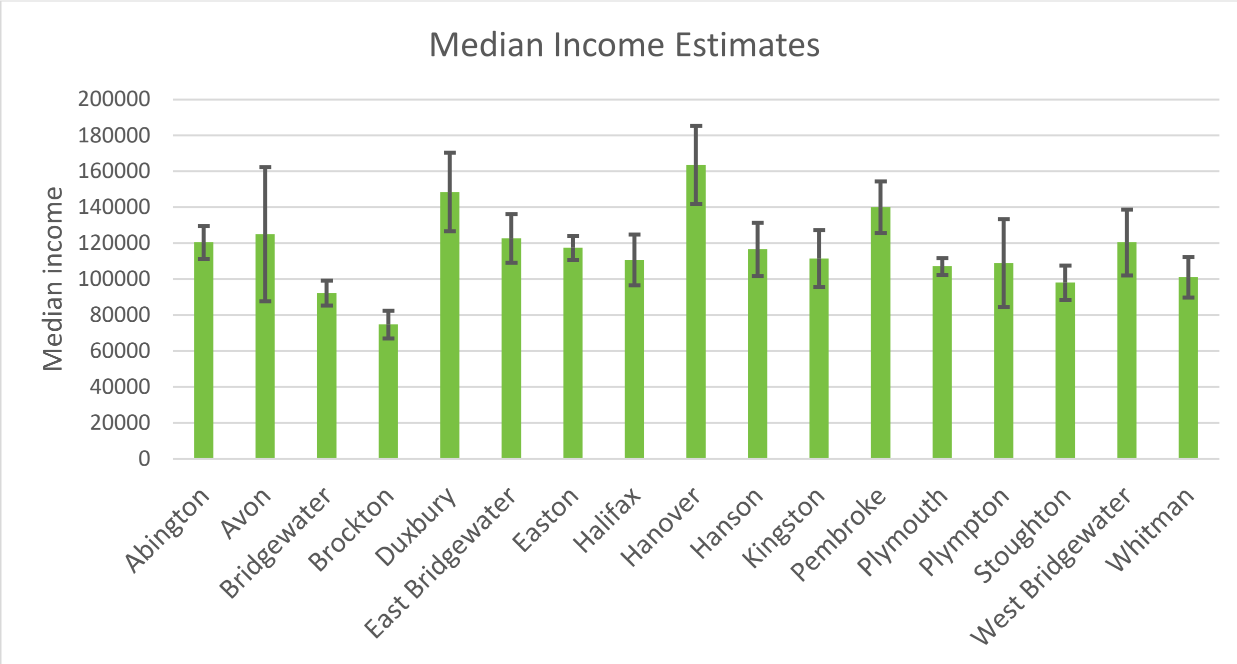


Note: 2020 population estimates based off data from the 2020 Census and 2050 data from UMDI V2022 analysis (United States Census Bureau 2021a; UMDI 2022)

Figure 2.1 2020 and 2050 Population Estimates

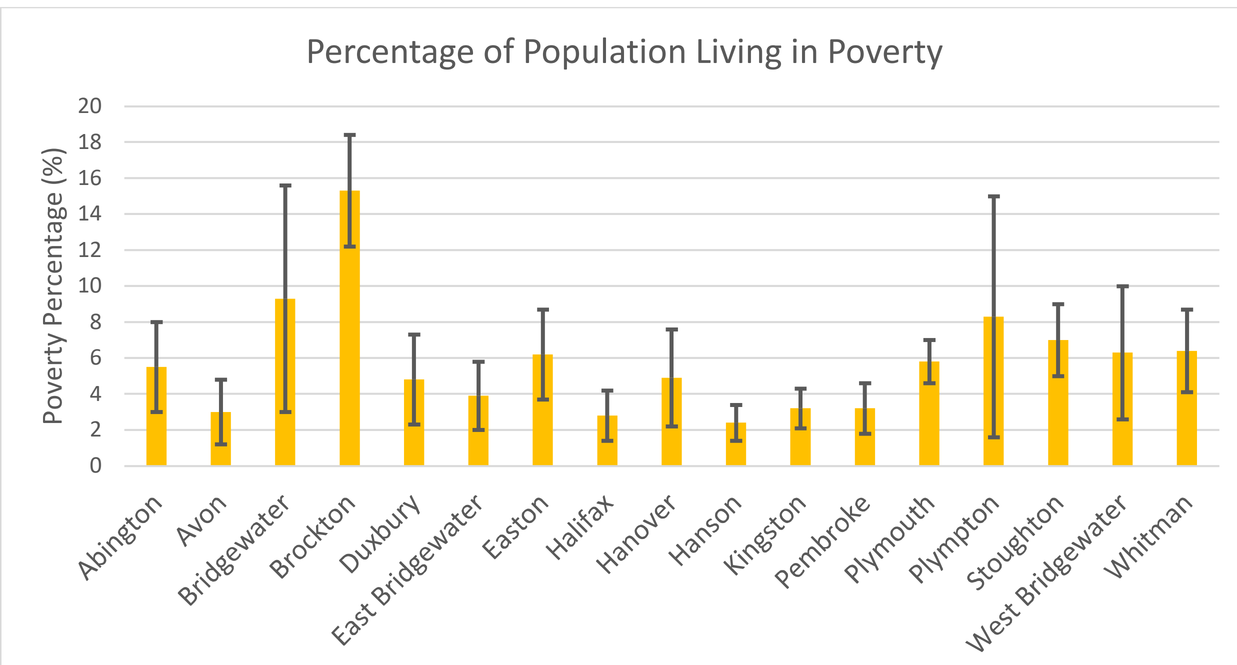
2.1.2 Income

Income data have also been provided. These data come from the 2018 and 2022 American Community Surveys (United States Census Bureau 2019; United States Census Bureau 2021b). **Figure 2.2** shows estimates of the median income per community. **Figure 2.3** shows estimates of the population per community that is living in poverty.



Note: Error bars are shown with the estimates. Data retrieved from the United States Census Bureau (United States Census Bureau 2019; United States Census Bureau 2020)

Figure 2.2 Median Income Estimates Per Community



Note: Poverty is defined per the United States Census Bureau, which uses a set of money income thresholds that vary by family size and composition to determine who qualifies as living in poverty. Data retrieved from the United States Census Bureau (United States Census Bureau 2018; United States Census Bureau 2020).

Figure 2.3 Percentage of Population in Each Community that is Living in Poverty

2.1.3 Environmental Justice

This section provides an overview of the environmental justice block groups included within each community, as defined by the Massachusetts Executive Office of Energy and Environmental Affairs. An environmental justice population is a neighborhood where one or more of the following are true (Massachusetts Executive Office of Energy and Environmental Affairs 2024):

- Block Group 1: The annual median household income is 65 percent (%) or less than the statewide annual median household income.
- Block Group 2: Minorities make up 40% or more of the population.
- Block Group 3: 25% or more of households identify as speaking English less than "very well."
- Block Group 4: Minorities make up 25% or more of the population and the annual median household income of the municipality in which the neighborhood is located does not exceed 150% of the statewide annual median household income.

Abington, Duxbury, East Bridgewater, Easton, Hanson, Kingston, Pembroke, Plympton, West Bridgewater, and Whitman have no census tracts categorized as environmental justice neighborhoods. **Table 2.1** details the environmental justice populations for Avon, Bridgewater, Brockton, Halifax, Hanover, Plymouth, and Stoughton, along with the criteria and the corresponding geographic areas.

Table 2.1 Environmental Justice Information Given by Community, Criteria, and Geographic Area

Municipality	Environmental Justice Criteria Description	Geographic Area
Avon	Minority	Block Group 1, Census Tract 4571 Block Group 2, Census Tract 4571 Block Group 3, Census Tract 4571 Block Group 4, Census Tract 4571
Bridgewater	Minority	Block Group 2, Census Tract 5614 Block Group 1, Census Tract 9802
	Minority and income	Block Group 1, Census Tract 9803
Brockton	Minority	Block Group 1, Census Tract 5101 Block Group 1, Census Tract 5102 Block Group 1, Census Tract 5105.04 Block Group 1, Census Tract 5106 Block Group 1, Census Tract 5110 Block Group 1, Census Tract 5111 Block Group 1, Census Tract 5113.02 Block Group 1, Census Tract 5114 Block Group 1, Census Tract 5116.01 Block Group 1, Census Tract 5116.02 Block Group 1, Census Tract 5117.01 Block Group 1, Census Tract 5117.02 Block Group 2, Census Tract 5101 Block Group 2, Census Tract 5102 Block Group 2, Census Tract 5105.01 Block Group 2, Census Tract 5106 Block Group 2, Census Tract 5107 Block Group 2, Census Tract 5108 Block Group 2, Census Tract 5111 Block Group 2, Census Tract 5112 Block Group 2, Census Tract 5113.01 Block Group 2, Census Tract 5114 Block Group 2, Census Tract 5116.01 Block Group 2, Census Tract 5117.01 Block Group 3, Census Tract 5101 Block Group 3, Census Tract 5102 Block Group 3, Census Tract 5105.01 Block Group 3, Census Tract 5105.03 Block Group 3, Census Tract 5106 Block Group 3, Census Tract 5111 Block Group 3, Census Tract 5113.01 Block Group 3, Census Tract 5113.02 Block Group 3, Census Tract 5114 Block Group 3, Census Tract 5115 Block Group 3, Census Tract 5117.01 Block Group 4, Census Tract 5101

Municipality	Environmental Justice Criteria Description	Geographic Area
		Block Group 4, Census Tract 5102 Block Group 4, Census Tract 5107 Block Group 4, Census Tract 5108 Block Group 4, Census Tract 5117.01 Block Group 5, Census Tract 5107 Block Group 5, Census Tract 5108 Block Group 6, Census Tract 5108
Brockton	Minority and income	Block Group 2, Census Tract 5104 Block Group 1, Census Tract 5104 Block Group 4, Census Tract 5104 Block Group 2, Census Tract 5113.02 Block Group 2, Census Tract 5110 Block Group 4, Census Tract 5114 Block Group 1, Census Tract 5113.01 Block Group 3, Census Tract 5116.01 Block Group 3, Census Tract 5116.02 Block Group 3, Census Tract 5112 Block Group 1, Census Tract 5105.01 Block Group 1, Census Tract 5105.03 Block Group 2, Census Tract 5105.03 Block Group 1, Census Tract 5105.05 Block Group 2, Census Tract 5105.05 Block Group 1, Census Tract 5107 Block Group 4, Census Tract 5115
	Minority and English isolation	Block Group 1, Census Tract 5103 Block Group 1, Census Tract 5108 Block Group 1, Census Tract 5115 Block Group 2, Census Tract 5116.02
	Minority, income, and English isolation	Block Group 1, Census Tract 5109 Block Group 1, Census Tract 5112 Block Group 2, Census Tract 5103 Block Group 2, Census Tract 5105.04 Block Group 2, Census Tract 5109 Block Group 2, Census Tract 5115 Block Group 3, Census Tract 5104 Block Group 3, Census Tract 5107 Block Group 3, Census Tract 5108
Halifax	Income	Block Group 4, Census Tract 5261
Hanover	Income	Block Group 4, Census Tract 5031.02
Plymouth	Minority	Block Group 5, Census Tract 5306
	Income	Block Group 1, Census Tract 5302 Block Group 2, Census Tract 5303

Municipality	Environmental Justice Criteria Description	Geographic Area
		Block Group 2, Census Tract 5305
Stoughton	Minority	Block Group 1, Census Tract 4561.01 Block Group 1, Census Tract 4561.02 Block Group 1, Census Tract 4562 Block Group 1, Census Tract 4563.01 Block Group 1, Census Tract 4563.02 Block Group 1, Census Tract 4564.01 Block Group 1, Census Tract 4564.02 Block Group 2, Census Tract 4561.01 Block Group 2, Census Tract 4561.02 Block Group 2, Census Tract 4562 Block Group 2, Census Tract 4563.01 Block Group 2, Census Tract 4563.02 Block Group 2, Census Tract 4564.01 Block Group 2, Census Tract 4564.02 Block Group 3, Census Tract 4561.02 Block Group 3, Census Tract 4564.02 Block Group 4, Census Tract 4563.02 Block Group 4, Census Tract 4564.02

2.2 Watersheds

The watersheds included in this plan are the South Coastal Basin, the Taunton Watershed, Buzzards Bay Watershed, Neponset Watershed, and Weir Watershed. As seen on **Figure 2.4**, Buzzards Bay, Neponset, and Weir are a much smaller portion of the study area. Because of their large portions covered by this Regional Water Plan, this annotated bibliography focuses on the South Coastal Basin and the Taunton Watershed. There are three United States Geological Survey (USGS) streamflow gauges located in the study area, details of which are included in **Table 2.2**.

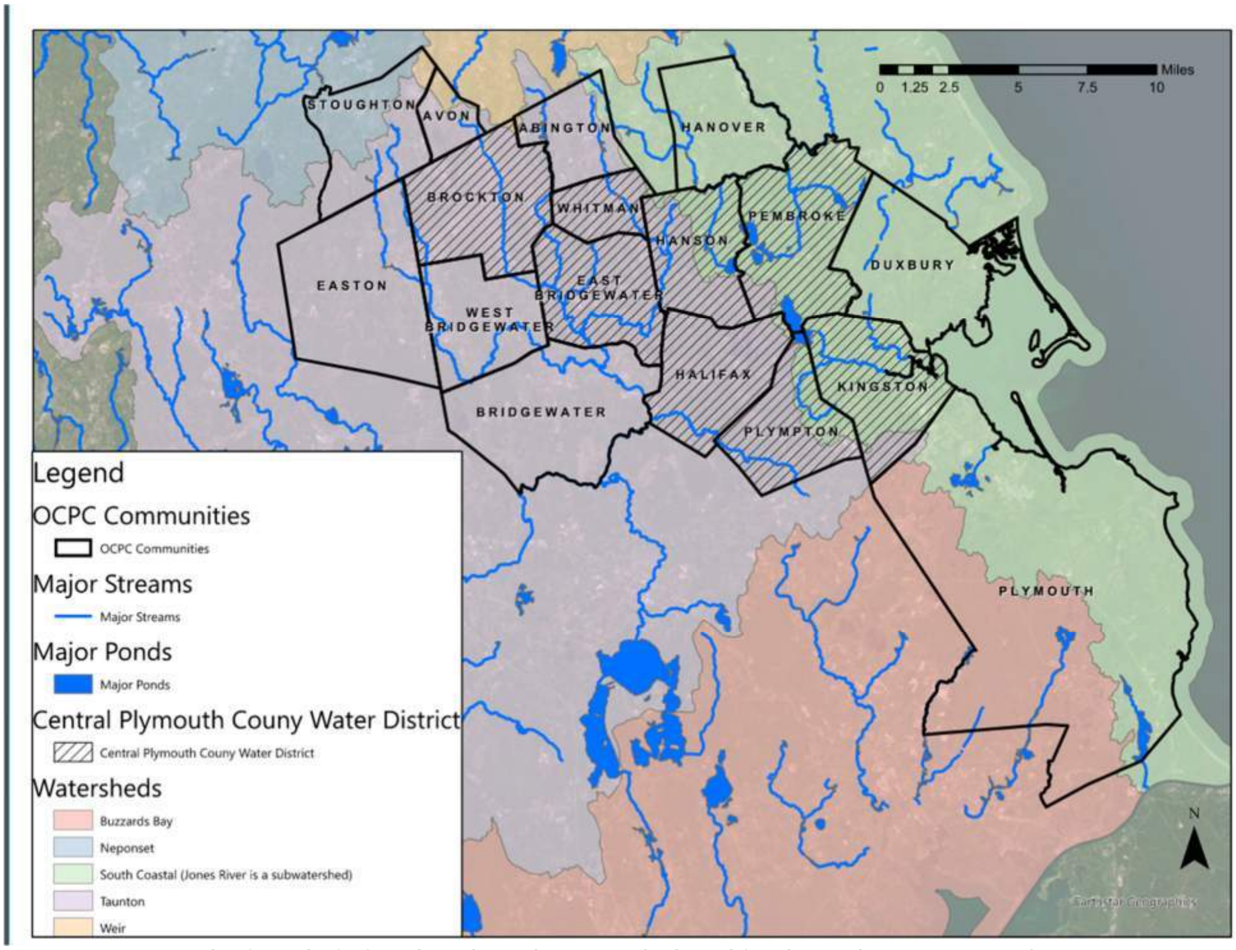


Figure 2.4 Watersheds Included in this Plan, Shown with the Old Colony Planning Council Communities

Table 2.2 United States Geological Survey Gauges Within Study Area

Gauge Name	ID	Dates Available
Taunton River near Bridgewater MA	01108000	1929–1976, 1985–1988, 1996–2023
Mill River at Spring Street	01108410	2005–2023
Jones River at Kingston MA	01105870	1966–2023

The Clean Water Act (CWA) mandates that states collect and report data on the quality of the nation's water resources to the U.S. Environmental Protection Agency (EPA), Congress, and the public. In response to this directive, Massachusetts has established the Watershed Planning Program (WPP) to oversee these efforts. The WPP is tasked with developing surface water quality standards, monitoring and evaluating water quality, and devising plans to restore and protect surface waters (MassDEP n.d).

Under the CWA, states must monitor and report on the condition of their water resources, assessing whether they meet designated uses. Massachusetts fulfills this requirement by conducting individual watershed water quality assessment reports, which serve as supporting documentation for the Integrated List. These reports compile data from various sources to evaluate water quality, track progress in maintaining and restoring it, and identify remaining challenges at the watershed level. Data on instream biological, habitat, physical/chemical, and toxicity indicators are analyzed to assess water quality conditions.

Both the South Shore Coastal Watersheds and Taunton Coastal Watersheds are assessed for various designated uses, including Aquatic Life, Fish Consumption, Drinking Water, Shellfish Harvesting, Primary and Secondary Contact Recreation, and Aesthetics. In 2001, Water Quality Assessment Reports were conducted for these watersheds to determine the support or impairment of each designated use (MassDEP 2001a, 2001b).

The CWA required the EPA and States to develop Total Maximum Daily Loads (TMDL) for pollutions violating or causing violation of water quality standards. A TMDL defines the maximum amount of the pollutant that a waterbody can assimilate while continuing to meet applicable water quality standards and allocates that maximum allowable pollutant load between point and nonpoint sources of the pollutant. Both the South Coastal Basin and Taunton River Basin have at least 1 pathogen-impaired segments with approved TMDLs (MassDEP, n.d). More information about impaired waters will be provided in Section 2.3 Surface Waters.

Massachusetts continues to monitor all watersheds statewide as part of MassDEP's ongoing monitoring program. The Integrated List of Waters is periodically updated to reflect the latest findings, with the most recent publication dating to 2022 (MassDEP 2022a).

2.2.1 Taunton River Watershed

The Taunton River Watershed spans 562 square miles and is the second largest watershed in Massachusetts, as shown on **Figure 2.5**. The landscape of the watershed was formed from glacial deposition, as shown in flat outwash plains, numerous wetlands, and kettle ponds. There are clay deposits and bog and iron within wetlands, both used in early development and industry. The watershed supports 31 distinct wildlife habitats, as well as rare reptiles, amphibians, birds, mammals, and freshwater mussels. The Taunton River Stewardship Plan outlines the management and protection of the river's resources. Important focuses of the plan are agriculture, ecology and biological diversity, history and archaeology, and recreation and scenery (Taunton Wild & Scenic River Study Committee 2005). **Table 2.3** includes the objectives for each of these focuses. The Taunton River Stewardship Plan provides a full list of identified actions.

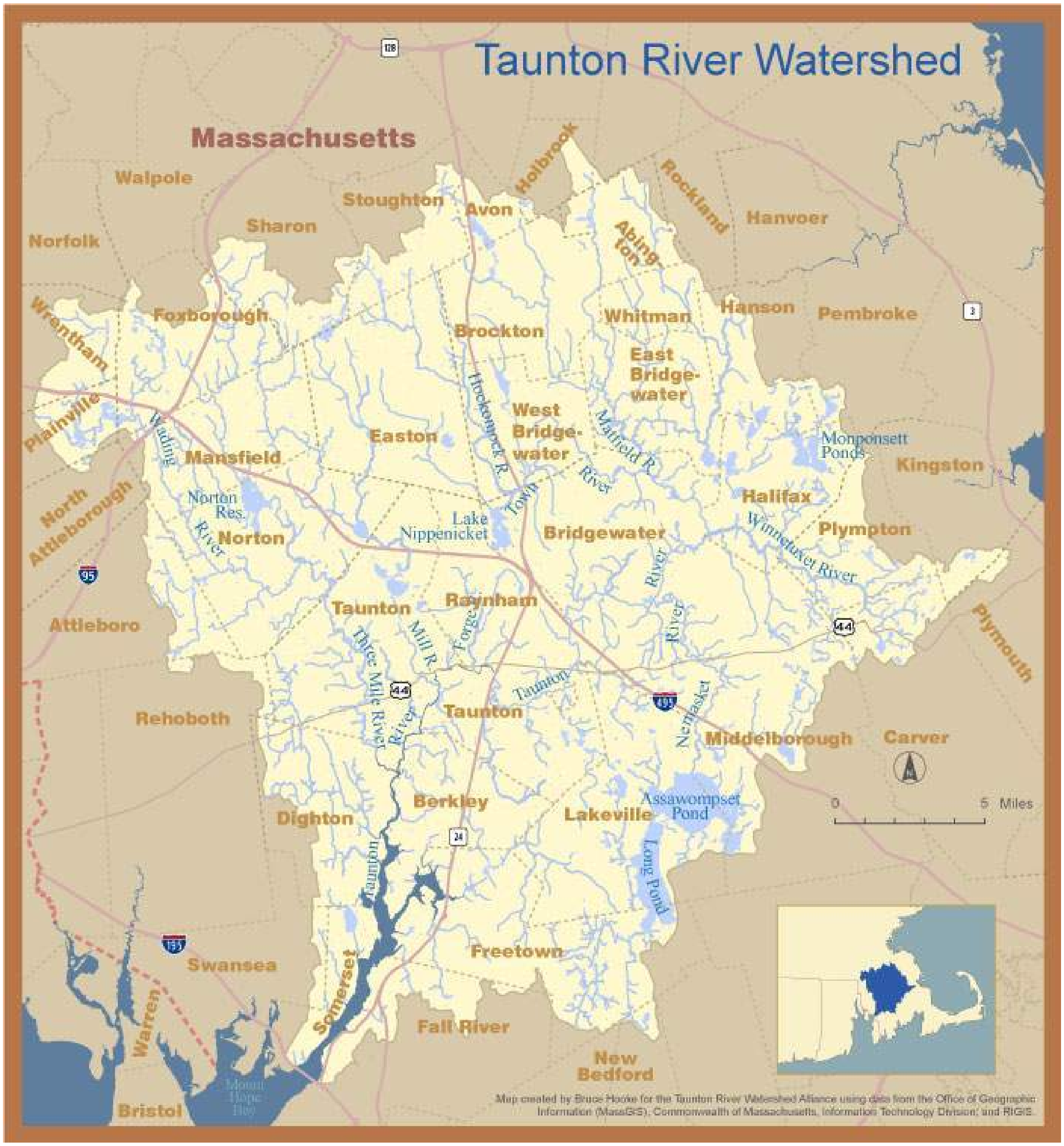


Figure 2.5 Map of the Taunton River Watershed (Taunton River Watershed Alliance 2024)

Table 2.3 Taunton River Stewardship Plan Focuses and Their Corresponding Objectives (Taunton Wild & Scenic River Study Committee 2005)

Focus	Objectives
Agriculture	▪ Protect agricultural landscapes and working farms for future generations ▪ Promote and support local farms and their markets to retain agriculture in the corridor ▪ Promote ecologically sensitive agricultural practices to manage runoff and conserve habitats
Ecology and Biological Diversity	▪ Increase public awareness of the ecology and biological diversity ▪ Protect water quality and natural flow ▪ Prevent fragmentation of wildlife corridors ▪ Prevent invasive species
History and Archaeology	▪ Increase public awareness of the historical and archaeological resources ▪ Inventory and document the historical and archaeological resources within the watershed ▪ Seek protection for threatened sites and areas of high archaeological sensitivity ▪ Support local planning efforts to manage development in a way that is compatible with the preservation and public education objectives
Recreation and Scenery	▪ Preserve the scenic beauty ▪ Ensure streamflow and water quality ▪ Protect connected open spaces ▪ Provide quality access ▪ Increase public awareness and appreciation of the river and tributaries

The Taunton River Stewardship Plan was followed by the Taunton River Watershed Management Plan, which is meant to be a comprehensive roadmap to protect and restore the Taunton River. It was split into three phases (Horsley Witten Group, Inc. 2008):

- Phase 1: Data collection, preliminary assessment, developing a long-term vision and scope for subsequent phases.
- Phase 2: Implementation of targeted pilot projects to highlight and demonstrate specific management measures.
- Phase 3: Widespread implementation of management measures and plan adaptations.

Phase 1 results indicated that historical land development and water withdrawals and discharges have resulted in shifts in hydrologic balances in many of the subwatersheds. These changes impact habitat and wetlands loss, which reduce natural pollution treatment and water storage. A major part of Phase 1 was also the development of the water balance. This study estimated the natural recharge to be 131 billion gallons per year. When anthropogenic groundwater withdrawals and discharges are accounted for across the whole watershed, the analysis shows that urbanization has resulted in net losses in groundwater recharge of approximately 6.2% (Horsley Witten Group, Inc. 2008).

Phase 2 included two projects located within Old Colony Planning Council (OCPC) communities, including:

- Low impact design parking lot and teaching tool at Bridgewater State University
- Parking lot retrofit at Belmont Street soccer fields in East Bridgewater

Both projects focused on treating stormwater before it was discharged to adjacent wetlands (Horsley Witten Group, Inc. 2011). It is unclear if Phase 3 of this project has been completed.

Advocates for the protection and stewardship of the Taunton River include the Taunton River Watershed Alliance, Taunton River Stewardship Council, and Wildlands Trust (Taunton River Watershed Alliance 2024; Taunton River Stewardship Council 2024; Wildlands Trust 2024).

2.2.1.1 Water Quality Monitoring

In addition to MassDEP's statewide watershed monitoring program, a crew of volunteers conduct monthly testing at 20 sites on the Taunton River and its tributaries. Data are available for 2016, 2017, 2018, 2019, 2021, 2022, and 2023. **Figure 2.6** shows these sampling locations. Water samples are tested for nitrate, total phosphorus, bacteria, dissolved oxygen, pH, and temperature. This sampling helps build the picture of the water quality issues this watershed faces. Primary issues include excess nutrients, including nitrogen and phosphorus, and stormwater runoff. Nutrient loading causes algae blooms, affecting fish and native vegetation, and stormwater transports pollutants, disrupting ecology (Taunton River Watershed Alliance 2023). The watershed alliance has recently focused on reducing nitrogen loading from wastewater treatment plants, including those for two OCPC communities, Brockton and Bridgewater. The watershed will also be affected by climate change as the cycle from intense rainfall and drought become more pronounced. Sea level rise will also lead to saltwater intrusion.

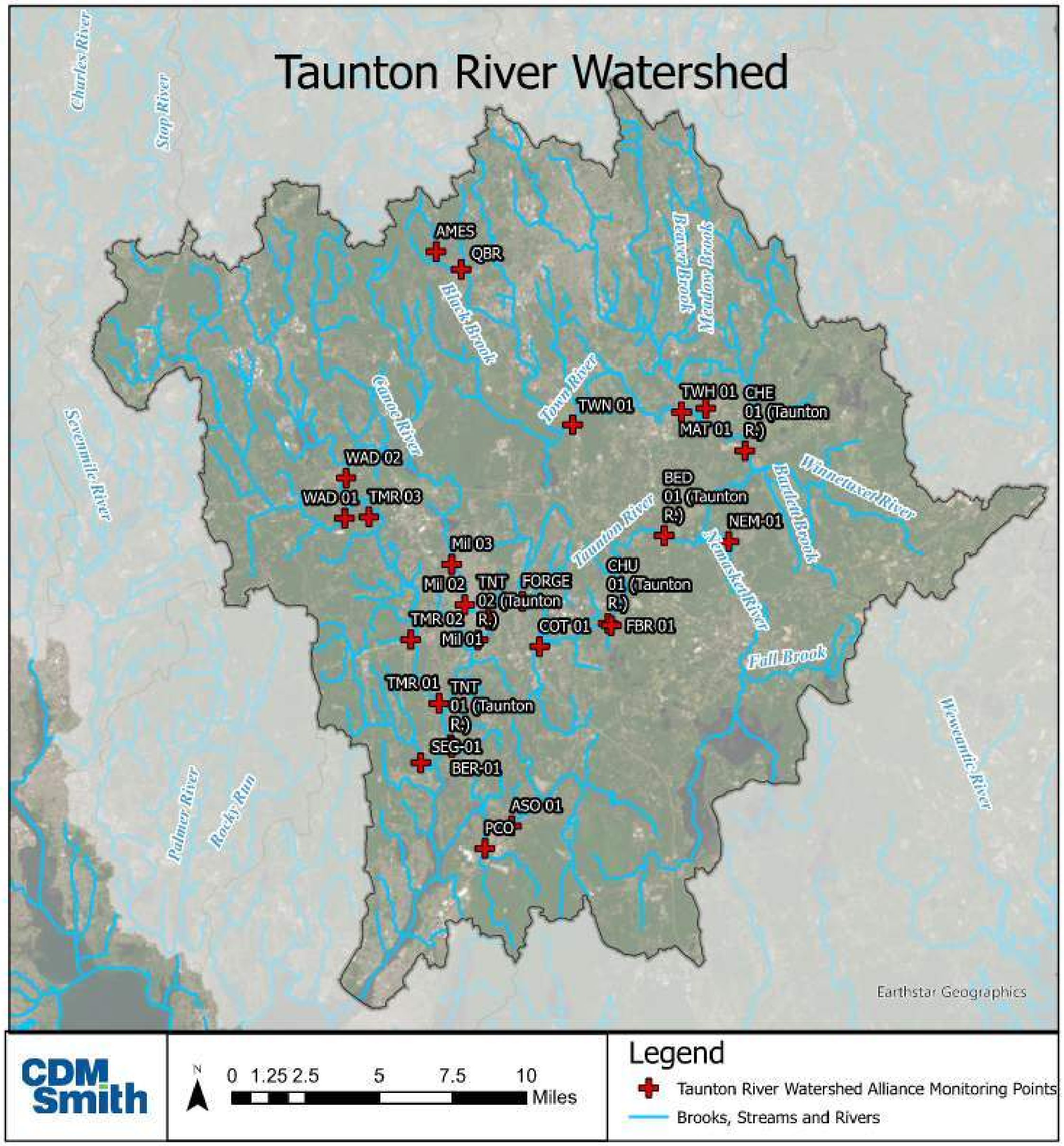


Figure 2.6 Taunton River Watershed Alliance Monitoring Points

2.2.2 South Coastal Basin

The South Coastal Basin is another major watershed included in this Regional Water Plan, as shown on **Figure 1.4**. There is no watershed association for this watershed, but there is a watershed association for the Jones River Watershed, a smaller portion of this larger basin. Details related to studies conducted in the Jones River Watershed are included in **Section 1.2.2.1**.

2.2.2.1 Jones River Watershed

The Jones River Watershed is approximately 29.8 square miles from Tubbs Meadow Brook to Kingston Bay. Much of the watershed is underlain by stratified drift. Silver Lake provides the headwaters for the Jones River, which flows about 7.5 miles east to Kingston Bay. The Upper Jones River, just downstream of the dam at Forge Pond, is reportedly seasonally dry (GZA GeoEnvironmental Inc. 2003).

Biological Diversity

The Jones River Watershed provides habitat for a variety of flora and fauna. In a Division of Marine Fisheries sampling conducted in 1998, several species were found including American eel, bluegill, sunfish, largemouth bass, tessellated darter, yellow perch, redfin pickerel, chain pickerel, and brook trout. Silver Lake is also habitat for two rare species of mussel, the eastern pond mussel and tidewater mucket (GZA GeoEnvironmental Inc. 2003). There has been a regional trend of decreasing herring populations, especially within the Jones River (Jones River Watershed Association 2022). Advocates for the protection and stewardship of the Jones River include the Jones River Watershed Association and the Jones River Landing Environmental Heritage Center.

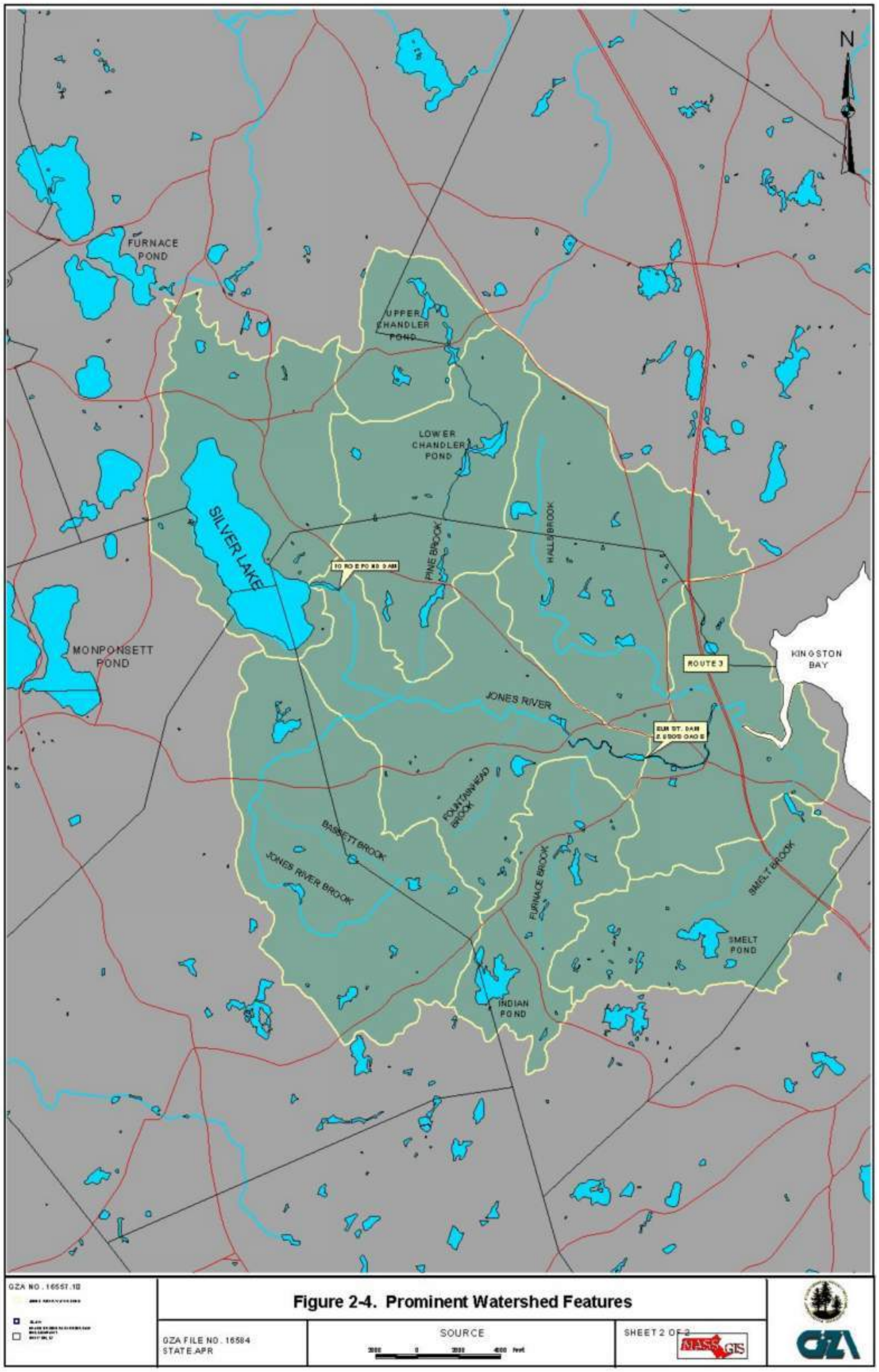


Figure 2.7 Map of the Jones River with Prominent Watershed Features (GZA GeoEnvironmental Inc. 2003)

Management

Silver Lake is the glacial headwater for the Jones River, formed 14,000 years ago. There have been many studies related to Silver Lake and Monponsett Pond and their management, including the Jones River Watershed Study (GZA GeoEnvironmental Inc. 2003), the River Herring Spawning and Nursery Habitat Assessment (Massachusetts Division of Marine Fisheries 2009), the draft Brockton Comprehensive Wastewater Management Plan (CWMP) Update (CDM Smith 2009), Sustainable Water Management Initiative (SWMI) project on Monponsett Pond (Princeton Hydro LLC 2013), and the Silver Lake and Tri-Basin Water Management Strategy Alternatives Report (Horsley Witten Group, Inc. 2016). These reports have been summarized as an overview to improve understanding of studies previously conducted in the watershed. Further, this section is intended to summarize the reports objectively and should not be construed as agreement or disagreement with them.

The Jones River Watershed Study was prepared for the Massachusetts Department of Environmental Management. The purpose of this report was to prepare a water use inventory as well as an inflow/outflow analysis for the Jones River watershed and it's subbasins. This report mentions that major water outflows include an interbasin transfer to the City of Brockton for the Public Water Supply, as well as smaller groundwater withdrawals from the nearby areas by the Town of Kingston, Town of Duxbury and Town of Pembroke for their municipal water supplies. Irrigation uses and flooding of cranberry bogs occurs during the non-winter season. The majority of the Jones River watershed contained flow rates to support aquatic habitat under the current level of permitted and registered water withdrawals. However, there are specific flow impaired portions of the watershed, including Upper Jones River, downstream of Forge Pond Dam, as well as Pine Brook. This study concluded that even under the most severe drought that Silver Lake would always flow to the Jones River under natural conditions. This report recommended further study of the flow-impaired sections of the watershed (GZA GeoEnvironmental Inc. 2003).

Massachusetts Division of Marine Fisheries (MassDMF) conducted a river herring spawning and nursery habitat assessment of silver lake from 2008-2009, in collaboration with the Jones River Watershed. At the time of assessment, two impassable dams prevented river herring from accessing the 643 acres of potential spawning and nursery habitat in Silver Lake. The study concluded that Silver Lake had suitable water quality conditions to support river herring spawning and nursery habitat requirements, despite being listed as impaired for multiple criteria. At the time of assessment, the most significant impairment for the goal of restoring river herring to Silver Lake was fish passage obstruction at Forge Pond Dam and reduced stream flow that could prevent juvenile herring emigration during summer and early fall. (MassDMF 2009). In 2019, a temporary fish ladder was installed at Forge Dam to aid in herring passage.

The draft Brockton CWMP report was completed to meet the special requirements of the modification of their WMA Permit #9p-4-25-044.01. This focused on developing a demand management plan and a water supply operations plan. The demand management plan outlined per capita use controls, such as a phased water ban, a public education program, reductions in unaccounted for water, meter maintenance and replacement, growth management, conservation at city facilities, water use permitting, and a conservation program for large water users. The water supply operations plan focused on supply management through reservoir levels at Silver Lake, Monponsett Pond, Furnace Pond, and Brockton Reservoir, as well as releases of water to Stump Brook, Herring Brook, the Jones River, and

Salisbury Brook. This plan also looked at the operating procedures for the desalination plant, Aquaria LLC and operation procedures during times of drought (CDM Smith 2009). The revised CWMP was targeted for 2023.

Halifax's SWIMI funded report on water management alternatives report discusses the different perspectives from stakeholders, including Brockton Water Supply (BWS) and groups interested in preserving the environmental character of Silver Lake. These stakeholders view BWS as combining three unique headwaters into a single management entity, sacrificing the environmental integrity by exporting the water to another region entirely. At the time of the study, the average BWS withdrawal from Silver Lake was approximately 9 MGD or more than 70% of the total Safe Yield estimate for the entire Jones River basin, as determined by the MassDEP Sustainable Water Management Initiative. Princeton Hydro concluded that current water management practices by BWS that involve Silver Lake/ Monponsett Pond/Furnace Pond are not sustainable. Furthermore, BWS is not the only public water supplier in the Jones River (or Taunton or North River) basin. The Towns of Kingston, Duxbury, Plympton, and Pembroke collectively withdraw approximately 1.7 MGD from the Jones River basin. This report recommended the use of the Aquaria desalination plant to resolve issues. BWS views the Silver Lake system as a commodity that is to be managed to facilitate meeting water demands of its consumers through cost-effective means. This report notes that BWS considers itself to promote water stewardship through reducing system leaks, improving water use efficiency, maintaining affordability for its consumers, and managing water levels in Monponsett Pond seasonally because of property owner requests (Princeton Hydro LLC 2013).

In 2013, Industrial economics prepared a report *Economic Evaluation of the Costs and Benefits of the Forge Pond Dam Fish Passage Improvement Alternatives* Industrial Economics Inc, 2013). This report serves as a companion document to the MassDMF report, described above. The analysis showed that at the time of this report, the incremental costs associated with the proposed fish passage alternatives would increase water rates on a cost per household basis in a range of $11 to $80 annually for users of Brockton's water. The report mentioned barriers to implementation of the fish passage alternatives include the City of Brockton's socio-economic conditions, the utilities need to resume its maintenance and capital replacement activities and the lack of political support to institute rate increases.

In 2016, the Horsley Witten Group submitted a report on water management alternatives for Silver Lake and the Jones River to the Massachusetts Division of Ecological Restoration. This paper refers to Brockton's water supply diversions as a "tri-basin" water diversion because of the following:

- Water is transferred from Furnace Pond in the North River Watershed to Silver Lake in the Jones River Watershed.
- Water is transferred from Monponsett Pond in the Taunton River Watershed to Silver Lake.
- Water is transferred from Silver Lake for final use by Brockton in the Taunton River Watershed.

This study evaluated two management alternatives:

1) Changing the rate and timing of diversions from Monponsett Pond into Silver Lake.
2) Changing the rate of withdrawals out of Silver Lake.

This analysis focused on evaluating the environmental impacts of these strategies but not addressing the feasibility of implementing them. For the first evaluated alternative, this study found that with no Silver Lake inflow diversions from Monponsett Pond, a 75% reduction in Brockton withdrawals would allow for Silver Lake elevations to be above the project's fish passage target of 1 foot of water over the out-migration notch of the Lake Street dam for the entire year. For a 50% reduction in withdrawals from Brockton, the lake elevation would not be above this target during the critical months of out-migration fish passage season in the fall. For the second alternative, elevations were simulated to remain above the critical target of 1 foot above the out-migration notch for the majority of the year if Brockton reduced withdrawals by 50%, assuming the current Monponsett Pond diversion period was from October to May. For the shortened Monponsett Pond diversion period between December and April, maintenance of simulated lake elevations above the critical target of 1 foot above the out-migration notch for the entire year would require a Brockton withdrawal reduction of 50% from December to April and no withdrawals between May and November. For the different alternatives, the maximum Jones River baseflow values were obtained during the management strategies that included inflow diversions from Monponsett Pond paired with significantly reduced Brockton withdrawals. This study did not address the feasibility of implementing these alternatives (Horsley Witten Group Inc. 2016).

<u>Water Quality</u>

In addition to concerns over the management of Silver Lake, Monponsett Pond and Furnace Pond, there are water quality concerns.

In 2021, Brockton released its Resource Management Plan for Monponsett Pond (CDM Smith 2021), addressing concerns such as cyanobacteria blooms, flooding impacts, and potential future degradation of water quality. The plan highlights the positive impact of measures implemented since 2016, including minimizing flood control diversion to Silver Lake and alum treatments, which have notably improved water quality. To sustain these improvements, the study recommends maintaining current operating procedures and suggests reducing water diversion to Silver Lake at the onset of algal blooms. Furthermore, it advocates for the development of a Total Maximum Daily Load (TMDL) Implementation Plan, increasing routine water quality monitoring, and continuing alum treatments. These recommendations aim to address ongoing challenges and ensure the long-term health of Monponsett Pond's ecosystem.

In 2022, MassDEP approved a TMDL for phosphorus in Monponsett Pond (MassDEP, 2022b). The diversion of water from Monponsett ponds has been shown to increase the loading of phosphorus in Silver Lake. As a result, Silver Lakes water quality is trending toward a eutrophic condition (TRC Environmental Corporation 2023). Stakeholders like the Central Plymouth County Water District Commission (CPCWDC) believe that a comprehensive approach is needed to address the source of flow alterations and phosphorus enrichment of Silver Lake and the waterbodies associated with the three sub watersheds. Recommendations included in the comprehensive approach include reducing the BWS diversion, improving stormwater management, establishing consistent by laws among the surrounding 8 communities, reducing water effluent from cranberry bogs, and evaluating alternative sustainable sources of drinking water.

In 2023, the final report for a water quality monitoring program for Silver Lake was released, funded by the CPCWDC. The CPCWDC was established in 1964 and serves Brockton, East Bridgewater, Halifax, Hanson, Kingston, Pembroke, Plympton and Whitman. This Commission is empowered to investigate and allocate water supply sources within the district, study water supply needs and resources, and investigate "all pertinent matters" relating to water quantity and quality, water resources protection, and water supply and treatment infrastructure. The CPCWDC is committed to ensuring safe, sustainable drinking water supplies, ecological health and recreational enjoyment within the Central Plymouth County Water District. The final report for a water quality monitoring program for Silver Lake, listed the relevant impairments to Silver Lake: fish passage barrier, flow regime modification, and dissolved oxygen. The impairment for dissolved oxygen requires a TMDL to be developed for Silver Lake. **Figure 2.8** includes sampling locations for this study (TRC Environmental Corporation 2023).

This study has technical findings related to aquatic invasive species, cyanobacteria, phosphorus, and dissolved oxygen. The report identified 3 aquatic invasive species including fanwort, variable-leaf milfoil, and Eurasian milfoil, as well as 16 native aquatic plant species. A large growth of cyanobacteria, a microscopic bacterium, results in an algal bloom that may be toxic to animals and people. Toxins produced by cyanobacteria were detectable in the lake, sometimes higher than state and federal health advisory levels. High concentrations of iron-bound phosphorus in Silver Lake sediments are likely resulting in elevated phosphorus release rates when oxygen depletion leads to anoxic conditions in deep waters. This typically occurs from June to October. Dissolved oxygen was typically low or absent from bottom waters, which impacts aquatic life including fish populations. To address these concerns, the report made the following recommendations:

- Model alternative management scenarios
- Develop a lake management plan for Silver Lake
- Continue the Silver Lake Water Quality Monitoring Program

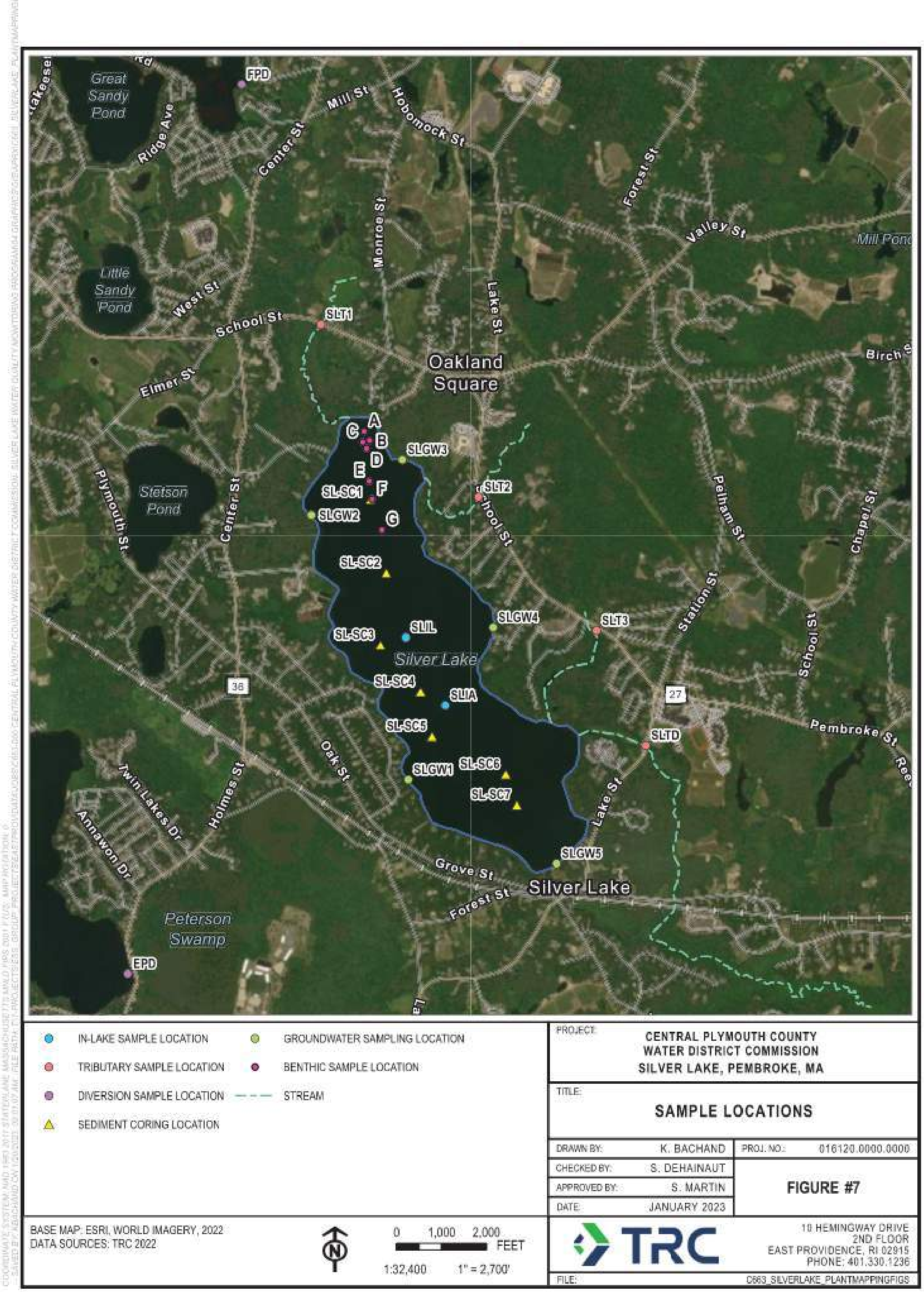


Figure 2.8 Silver Lake Water Quality Monitoring Locations (TRC Environmental Corporation 2023)

2.3 Water Management Act

The Water Management Act (WMA) became effective in March 1986, authorizing the Massachusetts Department of Environmental Protection (MassDEP) to regulate the quantity of water withdrawn from both surface and groundwater (Massachusetts General Court 1986). Water users are regulated through either the registration program or the permit program. Prior to January 4, 1988, large water users had the ability to register their water withdrawals based on their water use between 1981 and 1985. The registration program established the renewable right of previously existing water withdrawals for these users. After 1988, the permit program has regulated plans to withdraw water from ground or surface sources exceeding an annual average of 100,000 gallons per day or 9 million gallons in any 3-month period. These users, if not previously registered, must apply for a WMA Permit. Water users that have a registration do not need a permit unless their withdrawals exceed their registered volumes, or they add new withdrawal points to their system (MassDEP 2024). For new public water supply sources, both WMA permits and new source approval are required. Any new withdrawals or increased volumes from existing sources exceeding 100,000 gallons per day require a review under the Massachusetts Environmental Policy Act.

2.3.1 Common Permit Conditions

For the communities included in this plan, additional restrictions may be triggered if certain conditions are met, including:

- Unaccounted for water exceeding 10% for 2out of every 3 years
- Residential gallons per capita demand (RGPCD) exceeding 65
- Declaration of a drought advisory or higher by Massachusetts Drought Management Task Force
- Additional non-essential outdoor water use restrictions based on streamflow requirements specific to the permit

Nonessential outdoor water use restrictions limit watering to no more than 2 days per week (before 9 am and after 5 pm) in most permits; however, when RGPCD exceeds 65, this watering must be reduced to no more than 1 day per week. Restricted nonessential outdoor water uses include:

- Irrigation of lawns via automatic irrigation systems or sprinklers
- Filling swimming pools
- Washing vehicles, except in a commercial car wash or as necessary for operator safety
- Washing exterior building surfaces, parking lots, driveways, or sidewalks, except as necessary to apply surface treatments such as paint, preservatives, stucco, pavement, or cement

2.3.2 The Massachusetts Sustainable Water Management Initiative

In 2012, the Commonwealth of Massachusetts released the SWMI Framework. The intent was to provide consistent and codified policy to support ecological needs and economic growth. Some important methodological changes were introduced that recompute available water for withdrawal (groundwater or surface water) based on hydrologic flow metrics. This, in part, replaces the 1996 guidance from Mass DEP on safe yield from water supply reservoirs, as described further below, and for permitting both surface and groundwater withdrawals in Massachusetts, based predominantly on impacted streamflow projections.

This brief summary is intended as an overview to improve understanding of regulatory methods during the OCPC planning process. It is not as an exhaustive resource or summary of SWMI or the WMA. It is aimed at highlighting key terms, principles, and methods in their most basic forms, without explaining all the relevant caveats and conditions. Further detail can be found in the Massachusetts Sustainable Water Management Initiative Framework Summary of 2012, published by the then Massachusetts Executive Office of Energy and Environmental Affairs (EEA).[1] Further, this summary is intended to summarize and interpret the SWMI principles objectively and should not be construed as agreement or disagreement with them.

Groundwater Permitting Principles: The intent of SWMI with respect to groundwater permitting is to update guidelines based on streamflow conditions and provide means for offsetting and/or mitigating streamflow impacts by withdrawers. The relevant WMA regulations are described in 310 CMR 36.14.

1) Step 1: Comparison of permit application to Baseline: New groundwater withdrawal requests are compared to the "Baseline" withdrawal rate, defined as the higher of 2003 to 2005 average use plus 5%, or 2005 use plus 5%. The new request is determined to be lower or higher than this baseline.
2) Step 2: Determine the permittee's Groundwater Withdrawal Level (1 through 5), which corresponds to ranges of alteration of unimpacted August median flow because of groundwater withdrawals, and which were correlated to aquatic habitat quality through USGS modeling (1 is less than 3% alteration, 5 is 55% or greater alteration). The Groundwater Withdrawal Levels for any location can be found using the WMA Permitting Tool database and Sustainable Water Management Initiative Interactive Map.[2]
3) Step 3: Determine if any requested increase in volume would result in backsliding, defined in the framework, and generally understood as resulting in decreased groundwater level or biological category.

The above determinations will categorize potential groundwater withdrawers into one of three tiers, as outlined (generally) below and in 310 CMR 36.19 through 36.21, and which are associated with relevant actions and conditions, as listed in **Table 2.4** (Massachusetts Executive Office of Energy and Environmental Affairs 2012).

[1] https://www.mass.gov/doc/framework-november-2012/download
[2] https://www.mass.gov/guides/sustainable-water-management-initiative-swmi-technical-resources

Table 2.4 Relevant SWMI Actions and Conditions for Groundwater Withdrawers (Massachusetts Executive Office of Energy and Environmental Affairs 2012)

Outcome of Steps 1-3			Tier	Actions * (See full SWMI framework for details)
Additional withdrawal above baseline	Change in Groundwater Withdrawal Level	Change in Biological Category		
No	**No**	**No**	1	▪ Minimize withdrawal impacts with demand management ▪ If already above 25% August median flow alteration, MINIMIZE** further impacts to the extent practical. ▪ If coldwater fishery is present, evaluate and consult with agencies to minimize impacts. ▪ Regulations (310 CMR 36.20(4) provides Tier 1 applicants to demonstrate that fluvial fish relative abundance exceeds the expected number of fish for that groundwater withdrawal category with a site-specific assessment.
Yes	**No**	**No**	2	▪ Continue demand management per (a) and (b) above. ▪ If Groundwater Withdrawal Level 4 or 5, of in Bio Category 1-3, develop MITIGATION** plan ▪ If already above 25% median August flow alteration, demonstrate no feasible alternative source if requesting more than 5% of the median August flow. ▪ Consult with agencies as appropriate.
Yes	**Either of These as Yes**		3	▪ Continue demand management per (1a) and (1b) above. ▪ Demonstrate no feasible alternative source less harmful ▪ If Groundwater Withdrawal Level 4 or 5, or in Bio Category 1-3, develop MITIGATION** plan ▪ Consult with agencies as appropriate.

**Permittees in any of the three tiers may be subject to seasonal streamflow criteria.*
*** Minimization and Mitigation Plans are two separate and formal processes outlined in the SWMI Framework*

Surface Water Permitting Principles: New SWMI guidelines replaced previous definitions and estimation techniques of safe yield of a surface water supply source for the purposes of permitting. Safe yield is newly defined by SWMI as the "maximum amount of water withdrawal that can be allowed at a major basin scale during drought conditions and incorporates both environmental protection factors and hydrologic factors. Safe Yield is calculated as 55% of the Drought Basin Yield plus Reservoir Storage Volumes." The terms in this definition (310 CMR 36.13) are described below:

Drought Basin Yield is Defined in SWMI: This is an estimate of annual drought flows and is the 12-month average of the Q90 flow for each month, or the average of 12 monthly values representing flows that are exceeded 90% of the time for their corresponding month. These statistics are based on a 44-year period of record.

55% Factor: SWMI committee members determined that flow alterations greater than 25% of the median August flow (Q50) could cause aquatic habitat degradation. Extrapolating this to each month and relating it to Q90, it was determined that 60% of Q90 in each month was roughly equivalent to 25% of Q50. Additional protection was added, and the amount of water that can be allocated per SWMI guidelines for surface water systems is 55% of the annualized Q90. This, then, is essentially the new cap on surface water allocation ("Safe Yield") for any system, except for systems with reservoirs that have more than 1 year of storage capacity.

Reservoir Storage Volumes: The WMA requires that reservoir storage volume be included in the development of Safe Yield values. Per earlier 1996 guidance, allowable withdrawals were determined through dynamic modeling of hydrology and reservoir operations, as reservoir storage can provide supplemental water during periods of natural drought. SWMI, however, significantly reduced the value associated with reservoir storage, allowing only reservoirs with more than 1 year of storage to be included in safe yield calculations. Only six reservoir systems in the state of Massachusetts have more than 1 year of storage capacity, and none in the OCPC region qualify for the storage credit. Hence, surface water safe yield for OCPC surface water providers, if written into a permit, does not include any consideration of reservoir storage (Massachusetts Executive Office of Energy and Environmental Affairs 2012).

2.3.3 Per- and Poly-Fluoroalkyl Substances

On October 2, 2020, MassDEP introduced a new drinking water regulation and MCL of 20 parts per trillion (ppt) for the sum of six per- and poly-fluoroalkyl substances (PFAS6). On April 10th 2024, the EPA announced the final National Drinking Water Standards for six PFAS (PFOS, PFOA, PFNA, PFBS, PFHxS and GenX). **Table 2.5** includes the MCLs for each of the six PFAS. There is also a hazard index MCL that applies for any mixture containing two or more of the PFAS.

Table 2.5 Numerical Levels for Compliance with EPA PFAS Regulations

PFAS	MCL (ng/L or ppt*)	Significant Figure Requirement	Rounding for Reporting Example
PFOA	4.0	2	Running annual average value (RAA) of 4.04 ng/L = round to 4.0 ng/L = **Compliance** RAA of 4.05 ng/L = round to 4.1 ng/L = **Exceedance**
PFOS	4.0		
PFNA	10	1	RAA of 14.9 ng/L = round to 10 ng/L = **Compliance** RAA of 15.0 ng/L = round to 20 ng/L = **Exceedance**
PFHxS	10		
GenX	10		
PFNA, PFHxS, GenX, and PFBS (Mixture)	HI Value of 1 (Unitless)	1	RAA of 1.49 = round to 1 = **Compliance** RAA of 1.50 = round to 2 = **Exceedance**

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3.0 Abington

3.1 Water Supply

Abington is supplied by three water sources operated by the Abington Rockland Joint Water Works (ARJWW). Approximately 8% of ARJWW's water comes from groundwater via four wells located on Meyers Avenue and 92% comes from two surface water reservoirs: Hingham Street Reservoir in Rockland and Great Sandy Bottom Pond in Pembroke (ARJWW 2022b).

ARJWW's current WMA Permit was issued in 2020. The permit specifies a maximum authorized annual average withdrawal limit (**Table 3.1**) and maximum daily withdrawal rate for each well (**Table 3.2**).

Table 3.1 ARJWW's Maximum Authorized Annual Average Withdrawal Compared with 2022 Usage

	2022 ASR	WMA Permit #9P2-4-21-251.01	
Water Source	Average Daily Withdrawal (MGD)	Registered + Permitted[4] Withdrawal, 2020–2025 (MGD)	Registered + Permitted Withdrawal, 2025–2030 (MGD)
Taunton River Basin (wells)	0.16	0.46 + no permit = 0.46	0.46 + no permit = 0.46
South Coastal Basin (surface water)	2.88	2.21 + 0.56 = 2.77 [5]	2.21 + 0.56 = 2.77
Systemwide	3.04	3.19[6]	3.36

Note: MGD = million gallons per day; ASR = Annual Statistics Report, Red Text = Violation

Table 3.2 ARJWW's Maximum Daily Withdrawal Rate Compared with 2022 Usage

	2022 ASR	WMA Permit #9P2-4-21-25.01	
Water Source	Maximum Daily Withdrawal (MGD)	Maximum Daily Withdrawal (MGD)	Maximum Average Daily Withdrawal (MGD)
Great Sandy Bottom Pond	1.94	6.00	2.00
Hingham Street Reservoir	1.72	2.20	1.23

According to the WMA Permit, ARJWW must ensure water quality protection at Hingham Street Reservoir and Great Sandy Bottom Pond Reservoir. To meet this condition, ARJWW developed an approved Surface Water Supply Protection Plan in 2013. However, the WMA Permit states that ARJWW had not yet demonstrated best effort in 2020 to ensure that the Towns of Abington, Rockland, Hingham, and Pembroke develop surface water protection bylaws and local land use controls for Hingham Street Reservoir and Great Sandy Bottom Pond (MassDEP 2020).

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[4] Registered + Permitted: Registrations refer to established renewable water withdrawals established prior to 1988. Permitted withdrawals refer to WMA Permits issued for withdrawals beyond any registration amounts for ground or surface water sources in excess of an annual average of 100,000 gallons per day or 9 million gallons in any 3-month period.

[5] Average annual withdrawals of up to 2.9 MGD from the South Coastal Basin are permitted upon the addition of additional approved mitigation activities.

[6] The authorized systemwide volumes are based on water needs forecasts prepared by the Department of Conservation and Recreation. Note that the systemwide withdrawal limit does not necessarily reflect the sum of both basin limits.

Additionally, ARJWW is impacted by the WMA Permit's mitigation condition. ARJWW's baseline withdrawal from the South Coastal Basin is 2.46 MGD (average withdrawal from 2003 through 2005 plus 5%). ARJWW is responsible for a mitigation volume of 0.44 MGD (baseline basin withdrawal subtracted from authorized basin withdrawal) (MassDEP 2020). As of 2022, MassDEP approved 0.301 MGD in mitigation, leaving 0.042 MGD required for 2020 to 2025, and an additional 0.130 MGD required between 2025 and 2030. If mitigation activities are not completed, the maximum average daily withdrawal is limited to 2.77 MGD (H2Olson Engineering, Inc. 2022).

3.1.1 Water Treatment

Table 3.3 describes ARJWW's four treatment plants. A $25 million state revolving fund loan was secured to implement upgrades to water treatment plants (WTPs) affected by per- and poly-fluoroalkyl substances (PFAS). Construction was expected to begin in 2023 (ARJWW 2022a).

Table 3.3 Treatment Plants and Capacities (ARJWW 2022b)

Name	Capacity (MGD)	Source	Treatment
Myers Avenue WTP	1.5	Myers Wells 1–4	Particle removal, corrosion control, disinfection, iron removal
Great Sandy Bottom WTP	6	Great Sandy Bottom Pond	Particle removal, disinfection, corrosion control, taste/odor control
Hingham Street WTP	3	Hingham Street Reservoir	Particle removal, disinfection, corrosion control, taste/odor control
Lincoln Street Chlorination Plant	7.5	Myers Wells 1–4 and Great Sandy Bottom Pond	Disinfection

3.1.2 Water Storage

Table 3.4 summarizes ARJWW's storage capacity.

Table 3.4 Storage Tanks and Capacities (ARJWW 2022b)

Name	Capacity (MG)	Storage Type
Great Sandy Bottom	0.75	Underground Storage Tank
Chestnut Street Tank	0.40	Elevated Storage Tank
White Rice Avenue Tank	0.50	Elevated Storage Tank
Hingham Street	2.00	Underground Storage Tank
Blue Rice Avenue Tank	0.50	Elevated Storage Tank
Lincoln Street Standpipe	1.25	Ground Level Storage Tank
Total	5.40	—

Note: MG = million gallons

3.1.3 Water Distribution System

In 2022, 86% of ARJWW water was distributed for residential use and 10% was for commercial/business use (ARJWW 2022b). **Table 3.5** provides information about the distribution system (ARJWW 2022b).

Table 3.5 Distribution System Information for the ARJWW(ARJWW 2022b)

Distribution System Information (2022)	
Number of Service Connections	11,607
Number of Distribution Systems	2
Finished Water Storage Capacity (MG)	5.4
Pumping Capacity (gpm)	4,200
Total Miles of Water Mains	126
Estimated Volume (MG) Lost to Leaks	94.9

3.1.4 Interconnections

ARJWW has the following emergency interconnections with neighboring towns (Shea 2024):

- Weymouth: Hannigan WTP (max cap 3 MGD) or Great Sandy Bottom WTP (max cap 6 MGD)
- Hingham: Hannigan WTP (max cap 3 MGD) or Great Sandy Bottom WTP (max cap 6 MGD)
- Norwell: Hannigan WTP (max cap 3 MGD) or Great Sandy Bottom WTP (max cap 6 MGD)
- Hanover: Hannigan WTP (max cap 3 MGD) or Great Sandy Bottom WT (max cap 6 MGD)
- Whitman: Myers Ave WTP (max cap 1.5 MGD) or Great Sandy Bottom WTP (max cap 6 MGD)

None of these connections have been used in recent years.

3.1.5 Private Wells

The Abington Department of Health has provided CDM Smith with a list of Private Wells.

3.2 Water Demand

Table 3.6 provides additional details about the town's water demand from 2022.

Table 3.6 2022 Water Demand Information for the ARJWW (ARJWW 2022b)

2022 Demand Information	
MDD (raw)	3.6 MGD
ADD (raw)	3.04 MGD
UAW	9%
RGPCD	57 gallons/person/day

Note: MDD = maximum daily demand; ADD = average day demand; UAW = Unaccounted for Water

A water supply assessment predicts that ARJWW has the potential to meet demand through 2025, provided they meet the WMA permit mitigation activities, are effective at controlling UAW, and the pace of development does not exceed what is projected (H2Olson Engineering, Inc. 2022). The same study also states that ARJWW would not be able to support its existing customers if the Myers Avenue wells were inoperable or placed out of service (H2Olson Engineering, Inc. 2022).

The Department of Conservation and Recreation's (DCR's) 65/10 systemwide forecast for ARJWW after 2025 is 3.43 MGD. The systemwide withdrawal request from ARJWW's 2012 permit application was 3.36 MGD after 2025. Abington's authorized systemwide withdrawals exceed DCR's demand forecast (MassDEP 2020).

Both the Towns of Abington and Rockland have Water Use Restriction Bylaws. Abington implements an outdoor restriction throughout the entire year on nonessential outdoor water per their WMA Permit. Watering may only occur from 7 to 8 a.m. and 8 to 9 p.m. (ARJWW 2022b).

A development at 0 Summer Street has been approved for 35,750 gallons. The Board of Water Commissioners denied plans for irrigation (Shea 2024).

3.3 Issues and Concerns

3.3.1 Water Supply Issues

- AJRWW exceeded the maximum average annual daily withdrawal rate for Hingham Street Reservoir in 2020, 2021, and 2022. Consequently, the South Coastal basin allocation, where the Hingham Memorial Reservoir and Great Sandy Bottom Pond are, average annual withdrawal was also exceeded in 2020, 2021, and 2022.
- According to the Water Supply Assessment conducted by H2Olson Engineering in 2022, , two of the four wells at Myers Avenue have been offline in recent years (H2Olson Engineering 2022). However, according to Liz Shea, Well #3 was never deactivated (Shea 2024).
- AJRWW has exceeded the approved pumping volume at two of the three active Myers Street wells (**Section 4.1**).
- AJRWW exceeded the 10% UAW standard in 2017 and 2018.

3.3.1.1 Water Quality Issues

- Residents expressed concern with increasing levels of phosphorus and associated potential for increased nuisance algal blooms in Island Grove Pond (Town of Abington 2020).

Per- and Poly-Fluoroalkyl Substances

- In Quarter 4, average 2023 results for PFAS6 were 25[7] ppt at Hingham Treatment Plant (Town of Abington 2023). Treatment plant upgrades for PFAS began in 2023 (ARJWW 2022a).
- A PFAS6 concentration of 31 ppt was reported in drinking water in 2022 (ARJWW 2022a). Treatment plant upgrades for PFAS began in 2023 (ARJWW 2022a).

3.3.2 Water Demand Issues

- According to **Table 3.1**, the actual average withdrawal from surface water sources exceeds the permitted values. The actual average withdrawal from groundwater wells is within the permitted values.
- ARJWW is concerned about a potential new well for development near the Hingham Street Reservoir. There is concern that a new well will draw from the reservoir and reduce the reservoir's water supply capacity. (ARJWW 2022b).

[7] Red Text = Violation

- ARJWW's plan for outdoor water use restrictions was less stringent than the MassDEP guidance developed in 2016.

3.3.3 Other Issues

- Residents expressed concern regarding the state of a 10-mile pipe from Great Sand Bottom Pond to Abington. It is the only pipe conveying water supply from Pembroke and it crosses several adjacent towns (Town of Abington 2020).
- A recent Drought Management Plan was not provided as part of this project. MassDEP was not able to approve ARJWW's Drought Management Plan, dated October 22, 2014, because it would likely prove inadequate during a severe drought (MassDEP 2020).
- The new plan must include demand reduction measures tied to benchmark levels within the reservoir.

3.4 Water Supply Alternatives

- Connect to Massachusetts Water Resource Authority (MWRA), conceptual Alternative 1 (CDM Smith 2022)
- MWRA study currently taking place through Environmental Partners Group (Shea 2024).
- ARJWW received a $50,000 MassDEP WMA grant to fund the development of an integrated reservoir model that will be used to identify, understand, and develop reservoir management strategies. The results of this study are not yet available (MassDEP 2023).
- ARJWW plans to achieve an addition 120,00 gpd in mitigation credit so they can maximize their authorized permitted withdrawal from the South Coastal Basin to 2.9 MGD (Shea 2024).
- ARJWW has secured a $2.2 million MassWorks grant to fund the activation of Myers Avenue Well 4 and connection to a treatment plant along with concurrent PFAS Treatment upgrade. Construction has begun. (Shea 2024).

3.5 Questions

Answers shown in blue are from email sent by Liz Shea on 5/13/2024

- Why does AJRWW not record the 0.6 MGD permit on their 2022 ASR? *Currently ARJWW is permitted to withdraw up to 2.77 MGD from the South Coastal Basin – this includes the mitigation credits WMA Program approved in our 2020 permit. If ARJWW wants to withdraw more than the approved 2.77 MGD, we will need to process additional mitigation and apply for a permit amendment. Our goal would be to get an additional 130,000 gpd to maximize up to 2.90 MGD.*
- When was Meyers Well 3 reactivated? *Well #3 has remained an active source (never deactivated)*
- Has the Town updated their Drought Management Plan since 2014, and has MassDEP approved it? *No*

- Can CDM Smith have access to Surface Water Supply Protection Plan? https://www.mass.gov/doc/abingtonrockland-joint-water-works-swap-report/download
- Has Abington used their emergency connections in recent years? No, not in Abington.
- Has the town secured a $2.2 million MassWorks grant to fund the activation of Myers Avenue Well 4 and connection to a treatment plant? Has construction begun? Yes to both questions.
- Are there plans in place for additional emergency water supplies? MWRA study currently taking place through Environmental Partners Group & Well #4 activation at Myers Ave will help with supply as well (occurring with the current PFAS Treatment Plant upgrade project).
- Does Abington have projections for future demand? ARJWW doesn't have this information
- Can you provide the town's historical population data and water use from 2000 to present? ASR's provided have all historical pumpage information.
- What are the main nonresidential uses? Is it mainly commercial/industrial or municipal/institutional? Are there any projected increases or decreases in nonresidential demand? Mainly Commercial
- Are projections available on the amount of units and timing associated the MBTA Community requirements? Are there estimates of water usage for these units? The development for 0 Summer Street project has been approved for 35,750 gallons. The Board of Water Commissioners denied the plans for irrigation.

3.6 References

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4.0 Avon

4.1 Water Supply

The Town of Avon has no surface water supply and relies 100% on groundwater. The town has seven groundwater wells; however, only six are active. The town also has seven pump stations, two water storage standpipes, three treatment plants, one water filtration plant, and one garage facility (Town of Avon 2022a).

Avon's current WMA Permit was issued in 2021. The permit includes only the Trout Brook Wellfield and specifies a maximum authorized annual average withdrawal limit (**Table 4.1**) and maximum daily withdrawal rate for that source (**Table 4.2**). To continue to meet the mitigation condition in the permit, Avon must continue to implement their wetland bylaws (MassDEP 2020).

Table 4.1 Avon's Maximum Authorized Annual Average Withdrawal Compared with 2022 Usage

	2022 ASR	WMA Permit #9P-4-25-018.01
Drinking Water Source	Average Daily Withdrawal (MGD)	Registered + Permitted[8] Withdrawal, 2020–2030 (MGD)
Taunton River Basin	0.36	0.45 + 0.16 = 0.61

Table 4.2 Avon's Maximum Daily Withdrawal Rate Compared with 2022 Usage

	2022 ASR	WMA Permit #9P-4-25-018.01
Drinking Water Source	Maximum Daily Withdrawal (MGD)	Maximum Daily Rate (MGD)
Trout Brook Wellfield	0.14	0.32

4.1.1 Water Treatment

The Town of Avon relies on three WTPs and one filtration plant, as detailed in **Table 4.3**.

[8] Registered + Permitted: Registrations refer to established renewable water withdrawals established prior to 1988. Permitted withdrawals refer to WMA Permits issued for withdrawals beyond any registration amounts for ground or surface water sources in excess of an annual average of 100,000 gallons per day or 9 million gallons in any 3-month period.

Table 4.3 Treatment Plants and Capacities (Town of Avon 2022b)

Name	Capacity (MGD)	Source	Treatment
Memorial Corrosion Control Facility	0.43	Memorial Well 1	Disinfection, corrosion control
Trout Brook Corrosion Control Facility	0.25	Theater Well 3 Connolly Road Well 4 Trout Brook Wellfield Satellite Wellfield 3A, 3B, and 3C	Disinfection, corrosion control
Porter Corrosion Control Facility	0.5	Porter Well	Disinfection, corrosion control
Guilbault Memorial Filtration Plant	0.83	Memorial Well 1 Theater Well 3 Connolly Road Well 4 Trout Brook Wellfield Satellite Wellfield 3A, 3B, and 3C	Disinfection, organics removal, iron removal

Note: Memorial and Trout Brook Corrosion Control Facilities feed into Gibault Memorial Filtration Plant.

4.1.2 Water Storage

The Town of Avon relies on two storage tanks, as detailed in **Table 4.4**.

Table 4.4 Storage Tanks and Capacities (Town of Avon 2022b)

Name	Capacity (MG)	Storage Type
Central Street Standpipe	1	Ground Level Storage Tank
Page Street Tank	1.5	Ground Level Storage Tank
Total	2.5	—

4.1.3 Interconnections

The Town of Avon has four interconnections with three surrounding water systems that can be used in an emergency. There are two connections with Stoughton and one connection each with Randolph and Brockton (Tata and Howard 2017). They have not been used in recent years.

4.1.4 Private Wells

CDM Smith has not received data related to private well use within Avon.

4.2 Water Demand

Table 4.5 provides additional details about the town's water demand.

Table 4.5 Water Demand Information for the Town of Avon

Demand Information (Town of Avon 2022b)	
MDD (raw)	0.606 MGD
ADD (raw)	0.36 MGD
UAW	16.4%
RGPCD	49 gallons/person/day

Note: Red Text = Violation

DCR calculates the forecast demand. **Table 4.6** shows the projected demand summary for 2020 ranged from 0.52 to 0.61 MGD. The actual ADD in 2022 was 0.34 MGD (**Table 4.5**), which is lower than the DCR projections.

Table 4.6 Department of Conservation and Recreation's Forecast

	Year	ADD (MGD)	Summer Average Day Demand (MGD)	MDD (MGD)
Projected DCR (based on performance standards of 65 RGPCD and 10% UAW)	2020	0.61	0.77	1.01
	2025	0.62	0.78	1.02
	2030	0.64*	0.81	1.06
Projected DCR (based on current water use)	2020	0.52	0.66	0.86
	2025	0.53	0.67	0.87
	2030	0.54*	0.68	0.89

Note: DCR data are provided by the Town of Avon.

*DCR Projected up to an additional 5% (0.03 MGD) to both of these volumes.

In accordance with their WMA Permit, Avon has chosen a calendar-triggered water restriction. The restriction is for handheld hoses only, with no watering between 9 a.m. and 5 p.m. (Town of Avon 2022b). Additionally, no irrigation systems may be connected to the town water supply (Town of Avon Water Division n.d.).

4.3 Issues and Concerns

4.3.1 Water Supply Issues

Avon exceeded 10% UAW from 2015 to 2018 and was required to make a Water Loss Control Program in 2020 (MassDEP 2020). In 2022, the town reported 18%[9] UAW in their ASR. Water lost to leaks and leak detection accounted for an estimated 44% of Avon's UAW (Town of Avon 2022b).

4.3.1.1 Water Quality Issues

Per- and Poly-Fluoroalkyl Substances

In the 2022 Annual Water Quality Report, Avon reported 14.1 ppt PFAS6 at Porter Well and non-detect PFAS6 at Gibault Memorial Filtration Plant. These concentrations do not exceed the current standards.

4.3.2 Water Demand Issue

- Avon has historically drawn less water than permitted and should be able to meet demand through 2030, unless water demand is higher than the DCR projections (Tata and Howard 2017).

[9] Red Text = Violation

4.4 Water Supply Alternatives

- The Town of Avon is unable to shift to a less impacted subbasin because all the town's sources exist within one subbasin; however, they can replace underperforming wells. In the Capital Efficiency Plan prepared by Tata and Howard (2017), it is recommended that the Town of Avon install replacement wells for Memorial Well 1, which has reached the end of its useful life, and Porter Well, which was installed in 1890.
- Connect to MWRA, conceptual Alternative 1 or Alternative 2 (CDM Smith 2022).
- Rehabilitate Page Street storage tank (Tata and Howard 2017).
- Consider replacement wells needs and/or reopen inactive Memorial GP Well 2 (Tata and Howard 2017).
- Consider formalizing interconnections with surrounding communities for emergency planning (Tata and Howard 2017).
- The town should complete a water supply and source evaluation to verify the pumping rates and specific capacities from each well (Tata and Howard 2017).
- In November 2023, the town approved funding to conduct a wastewater and water connection feasibility study of MWRA, or the City of Brockton, and/or wastewater disposal for Avon Industrial Park and Stockwell Drive (Town of Avon 2023). The results of this study are not yet available.

4.5 Questions

Answers shown in blue were provided during an interview with Jonathan Beder held on May 17, 2024.

- Did town replace Porter Well? There is a reference to it in the 2021 annual town meeting. Town considering adding treatment at the Porter well.
- Are there several known private wells in town? None
- Are the results of the wastewater and water connection feasibility study available? Not yet
- Is the interconnections section correct? Are these one-way interconnections, two-way connections, or emergency connections? What is the capacity and source location for these? Is the water treated or raw? Are there any blending issues? The mentioned interconnections have not been used.
- Are there plans in place for additional emergency water supplies? Avon exploring alternative water supply source and treatment at Porter well.
- Does Avon have projections for future demand? DCR projections were updated in 2021. Avon is looking to bring sewer to Industrial Park, which could bring redevelopment potential.

4.6 References

CDM Smith. 2022. MWRA Expansion Study.

Massachusetts Department of Environmental Protection (MassDEP). 2020.WMA Permit #9P-4-25-018.01.

Tata and Howard. 2017. Draft Capital Efficiency Plan.

Town of Avon. 2023. Special Town Meeting.

———. 2022a.Annual Water Quality Report.

———. 2022b. Annual Statistics Report.

Town of Avon Water Division. n.d. Water Rates and Tax Bills. https://www.avon-ma.gov/water-division/pages/water-rates-tax-bills.

5.0 Bridgewater

5.1 Water Supply

Bridgewater draws from three wellfield within the Taunton River Basin. The first wellfield is located on High Street near the Matfield River (Wells 3, 6, 8, and 9). The second wellfield is located near Carver's Pond (active wells include Wells 2, 4a, and 5a). The third wellfield has two wells and is located on Plymouth Street (Wells 10A and 10B) (Town of Bridgewater 2022b).

Bridgwater's WMA 2021 Permit specifies a maximum authorized annual average withdrawal limit (**Table 5.1**) and maximum daily withdrawal rate for each well (**Table 5.2**). In 2016, Bridgewater filed to add two additional wells to their permit, the Vernon Street wells. The permit of these two wells was approved but they have not yet been constructed.

Table 5.1 Bridgewater's Maximum Authorized Annual Average Withdrawal Compared with 2022a Usage

	2022 ASR	WMA Permit #9P-4-25-042.01	
Drinking Water Source	Average Daily Withdrawal (MGD)	Registered + Permitted[10] Withdrawal, 2020–2025 (MGD)	Registered + Permitted Withdrawal, 2025–2030 (MGD)
Taunton River Basin	1.61	1.66 + 0.2 = 1.86	1.66 + 0.32 = 1.98

Table 5.2 Bridgewater's Maximum Daily Withdrawal Rate Compared with 2022 Usage

	2022 ASR	WMA Permit #9P-4-25-042.01
Drinking Water Source	Maximum Daily Withdrawal (MGD)	Maximum Daily Rate (MGD)
High Street Well 3	0.38	Combined High Street wells not to exceed 1.62
High Street Well 6	0.36	
High Street Well 8	0.62	
High Street Well 9	0.19	
Carver's Pond Well 2	0.46	0.58
Carver's Pond Well 7	INACTIVE	0.14
Plymouth Street Well 10A	0.332	0.23
Plymouth Street Well 10B	0.298	0.31
Carver's Pond Well 5A	0.25	0.24
Carver's Pond Well 4A	0.45	0.43
Vernon Street Well 1	Offline	Combined Vernon Street wells not to exceed 0.56
Vernon Street Well 2	Offline	

Note: Red Text = Violation

[10] Registered + Permitted: Registrations refer to established renewable water withdrawals established prior to 1988. Permitted withdrawals refer to WMA Permits issued for withdrawals beyond any registration amounts for ground or surface water sources in excess of an annual average of 100,000 gallons per day or 9 million gallons in any 3-month period.

Bridgewater fulfilled the mitigation condition in their permit through their Inflow and Infiltration (I/I) Operation and Maintenance Plan and a Stormwater Management Bylaw (MassDEP 2021).

5.1.1 Water Treatment

Table 5.3 describes Bridgewater's six treatment plants.

Table 5.3 Treatment Plants and Capacities (Town of Bridgewater 2022a)

Name	Capacity (MGD)	Source	Treatment
Well House 3	0.5	Well 3	Iron removal
Well House 6	0.22	Well 6	Iron removal
Nitrate Plant	0.72	Wells 3 and 6	Corrosion control, disinfection
High Street Water Treatment Plant (online in 2023)	2.2	Wells 3, 6, 8, and 9	Disinfection, iron and manganese removal, corrosion control
Pump House 8/9	0.72	Wells 8 and 9	Iron removal, Disinfection, corrosion control
Pumping Station Wells 10A and 10B	0.54	Wells 10A and 10B	Disinfection, corrosion control
Carvers Pond Treatment Plant 1/2/4A/5A	1.8	Wells 1 and 2, Wells 4A and 5A	Disinfection, iron and manganese removal, corrosion control

5.1.2 Water Storage

Table 5.4 summarizes Bridgewater's storage tanks and associated capacity.

Table 5.4 Storage Tanks and Capacities (Town of Bridgewater 2022a)

Name	Capacity (MG)	Storage Type
Great Hill Standpipe	0.9	Elevated Storage Tank
Sprague Hill Standpipe	3.9	Elevated Storage Tank
Total	4.8	—

5.1.3 Water Distribution System

In 2022, 89% of Bridgewater's water was distributed to residential areas. **Table 5.5** provides information about the Bridgewater's distribution system.

Table 5.5 Distribution System Information for the Town of Bridgewater (Town of Bridgewater 2022a)

Distribution System Information	
Number of Service Connections	7,868
Number of Distribution Systems	1
Finished water Storage Capacity (MG)	4.8
Pumping Capacity (gpm)	1,800
Total Miles of Water Mains	130
Estimated Volume (MG) Lost to Leaks	N/A

Note: N/A = not available

5.1.4 Interconnections

There is no mention of interconnections in any Bridgewater-specific documents; however, East Bridgewater mentions having an emergency interconnection.

5.1.5 Private Wells

The Kingston Board of Health keeps records of all the residents on private wells. Locations of private wells and other information such as water quality, pumping rates, and domestic use or irrigation only are contained in the well permit data. Approximately 1440 private wells have been drilled and permitted (O'Brien 2024).

5.2 Water Demand

Table 5.6 includes additional details of the town's water demand from 2022.

Table 5.6 Water Demand Information for the Town of Bridgewater

Demand Information	
MDD (raw)	2.3 MGD
ADD (raw)	1.61 MGD
UAW	7.3 %
RGPCD	45 gallons/person/day

Note: Red Text = Violation. MDD and UAW data comes from (Town of Bridgewater 2020), while ADD and RGPCD data comes from (Town of Bridgewater 2022a)

DCR's forecast projections were not provided for Bridgewater.

Bridgewater provided the following demand estimates via email correspondence (O'Brian 2024). See **Table. 5.7**

Table 5.7 Water Demand Projections from the Town of Bridgewater

Year	Demand Projection (MGD)
2025	2.58
2030	2.57
2035	2.5
2040	2.6
2045	2.6

According to their WMA Permit, Bridgewater must implement either a calendar or streamflow-triggered restrictions on nonessential outdoor water use. Under both the calendar and streamflow trigger options, watering must be reduced to 1 day per week when the annual 7-day low-flow trigger of 47 cubic feet per second (cfs) occurs at USGS Monitoring Location #01108000 (MassDEP 2021).

5.3 Issues and Concerns

5.3.1 Water Supply Issues

- There were concerns during the Municipal Vulnerability Preparedness (MVP) workshop about adequate storage capacity during a drought (Green International Affiliates 2019).
- According to **Table 5.2** and **Table 5.6**, Bridgewater's 2022 UAW exceeded the 10% standard and they withdrew more than authorized at Plymouth Street Well 10B, Carver Pond Well 5A, and Well 4A.

5.3.1.1 Water Quality Issues

- In 2023, 4/36 drinking water sites tested exceeded the action level for lead and 3/52 sites exceeded the action level for copper (Town of Bridgewater 2023).
- Water quality contaminants that were reported exceeding their SMCL or Office of Research and Standards Guidelines (ORSG) between 2022 and 2023 are reported in **Table 5.8** (Town of Bridgewater 2022b 2023).

Table 5.8 Secondary Contaminants Exceeding Secondary Maximum Contaminant Level between 2022 and 2023

Contaminant	Average	SMCL/ORSG	Year Tested
Sodium	82.9 ppm	20 ppm	2022
Manganese	170 ppb	50 ppb	2023
Odor	8 TON	3 TON	2023
Acetone	11.2 ppm	6.3 ppm	2023

Note: Red Text = Violation; ppm = parts per million; ppb = parts per billion, TON= threshold odor number

Per- and Poly-Fluoroalkyl Substances

- In 2023 and 2024 (through March),PFAS6 concentrations from all wells exceeded 9 ppt, with concentrations peaking at 24.7 ppt. Bridgewater also tested for unregulated PFAS compounds PFBS and PFHxA, which were found at peak concentrations of 4.9 and 8.3 ppt, respectively. (Town of Bridgewater 2023).

5.3.2 Water Demand Issues

- Bridgewater should be able to meet normal demand under current conditions. However, there is concern about water supply during high seasonal peaks, power outages, or during periods of extreme drought (Green International Affiliates 2019).

5.3.3 Other Issues

- Bridgewater has lost a lot of farmlands over the last 50 years and has put agricultural preservation initiative in place (Green International Affiliates 2019).

- The town is concerned about their wastewater treatment plant's ability to treat wet weather flows. An update of the facility is in the works (Green International Affiliates 2019).
- Some of Bridgewater's older septic systems are below the seasonal high-water table and many of the systems are in floodplains (Green International Affiliates 2019).

5.4 Water Supply Alternatives

- Construct the Vernon Street wells. If/when the town decided to put the wells online, they will need to take the following actions per their WMA Permit:
  - Obtain a permit from the MassDEP prior to the start of construction.
  - Implement appropriate well head protection zoning or non-zoning controls.
  - Obtain a vegetation management plan from the power company that prohibits herbicide use near the wells.
- Route Plymouth wells to the new High Street Treatment plant (O'Brien 2024).

5.5 Questions

Answers from email from Shane O'Brien sent on May 24, 2024 (in blue) and Environmental Partners (in green) received June 13, 2024 from Greg Tansey.

- Bridgwater reported total raw water pumped as 612.415 MG in Table BW-2 and 627.813 MG under the water production and consumption information. Why do these numbers differ? The 612.4133 MG (Table DS-5) is Finished Water, Table BW-2 "Raw Water" is an Operator error mis-print and should read "Finished Water".
- Are there any generators for water supply during a power outage? Yes, Bridgewater has three generators at Plymouth Street, Carvers Pond, and the Hight Street pumping stations.
- Aside from demand in 2020, were there any other reasons for well overdraws in 2020? The 2020 demand was a temporary condition precipitated from the Covid 19 shutdowns.
- The MVP states, "some of the aquifers have recharge areas that are tapped into during a six-month drought." What does this mean? We could not find this reference in the MVP. It appears that this section of the MVP was prepared by someone other than an operator and simply made an inaccurate statement. EP reviewed the Green Affiliates MVP and did not find specific details on the impact to the aquifers. EP recommends speaking with Jonas Kazlauskas, Water & Sewer Superintendent, for additional context on this item.
- Is the interconnections section correct? Are these one-way interconnections, two-way connections, or emergency connections? What is the capacity and source location for these? Is the water treated or raw? Are there any blending issues? The interconnections have not been used in 20 years or more if any. The interconnections are for emergency use. Interconnections transmit treated water only. Never had any blending issues the interconnections are for emergency conditions only. The interconnections are passive (not pumped) and unmetered. It is not known which direction they would flow when opened without further investigation into the HGL ranges of neighboring systems. EP recommended further investigation in the WSMP. In

addition, the interconnections have not been regularly exercised and their current condition is unknown.

- Are there plans in place for additional emergency water supplies? EP recommended and is working with the Department to pursue several supply sources. One is to begin improvements to the Plymouth Wells that will recover their capacity by routing them to the High Street WTP. EP also recommended continuing to pursue the Vernon Street Wells, which will add more buffer against an emergency supply scenario. As discussed above, EP also recommended further investigation into the feasibility and capacity of neighboring interconnections such that they can be factored into the supply landscape in emergency scenarios.
- Is there information on the number of residents on private wells? Are approximate locations available? Yes, the Board of Health keeps records of all the residents on private wells. Locations of private wells and other information such as water quality, pumping rates, and domestic use or irrigation only are contained in the well permit data. Approximately 1,440 private wells have been drilled and permitted.
- Does Bridgewater have projections for future demand? Yes, 2025 2.58 MGD, 2030 2.57 MGD, 2035 2.50 MGD, 2040 2.6 MGD, 2045 2.6 MGD. EP provided demand projections as part of the WSMP in accordance with the MassDEP WRC methodology (65/10). However, Bridgewater's historic residential gallons per capita per day (RGPCD) averages closer to 47, well below the standard of 65. EP provided an alternate projection using this average of 47 as a point of comparison
- Are projections available on the amount of units and timing associated the MBTA Community requirements? Are there estimates of water usage for these units? 1,401 Units, MBTA community projects are currently in the permit process. Water and Sewer capacities are limited.

5.6 References

Green International Affiliates. 2019. Municipal Vulnerability Program Plan.

Massachusetts Department of Environmental Protection (MassDEP). 2021. WMA Permit #9P-4-25-042.01.

Town of Bridgewater. 2023. Annual Water Quality Report.

———. 2023. PFAS6 Notice.

———. 2022a. Annual Statistics Report.

———. 2022b. Annual Water Quality Report.

O'Brien, Shane. 2024. Email Response to Questions

University of Massachusetts Donahue Institute. 2022. UMDI-DOT Vintage 2022 projection (Link).

6.0 Brockton

6.1 Water Supply

Brockton is supplied by three water sources: the interconnected system of Monponsett Pond, Furnace Pond, and Silver Lake; the Brockton Reservoir; and the Aquaria Desalination Plant. The City of Brockton has two WMA registrations and one WMA Permit. The Acts of 1964 in the *Massachusetts Acts Chapter 371: An Act Establishing the Central Plymouth County Water District and Authorizing the City of Brockton to Extend its Source of Water Supply* authorized Brockton to extend its water supply to Furnace Pond, Monponsett Pond, and Silver Lake (Massachusetts General Court 1964a and 1964b). The Acts of 1981 in *Massachusetts Acts Chapter 237: An Act Further Regulating the Source of Water Supply for the City of Brockton* further regulated the source of water for Brockton, clarifying that water must not be withdrawn from Furnace Pond if the elevation is below 56 feet or from Monponsett Pond if the elevation is below 52 feet elevation, in Unites States Coast and Geodetic Survey datum (Massachusetts General Court 1981). Registrations were issued in the late 1980's. MassDEP issued renewed registration statements for Brockton's withdrawals from the South Coastal Basin and the Taunton River Basin on April 8, 2023, that expire April 7, 2033 (MassDEP 2023a and 2023b). These were conditionally accepted with requests for correction. Additionally, the City of Brockton submitted a program modification request to DEP in June 2023 for normal variation that they have not heard back about. The names of the registrations and their numbers are listed below, with additional details provided in **Table 6.1**. **Figure 6.1** shows a schematic of Brockton's water system.

The South Coastal Basin Registration Statement 42104401 authorizes an average daily withdrawal of 11.11 MGD from the Silver Lake system. While Monponsett Pond is located within the Taunton River Basin, its withdrawal is included in the South Coastal registered average daily withdrawal because it is hydraulically connected to Silver Lake.

The Taunton River Basin Registration Statement 42504402 sets an allowable withdrawal from Hubbard Avenue well at 0.04 MGD. The use of this well requires permission from DEP under a Declaration of Water Supply Emergency prior to its use.

The Taunton River Basin Permit 9P-4-25-044.01 includes Brockton Reservoir, also called the Avon Reservoir. It authorized average withdrawals of 0.83 MGD (daily average). This permit also authorizes the purchase of up to 4.07 MGD from the Aquaria Desalination Plant. The Aquaria Desalination Plant typically provides drinking water to the city during the summer months, when demand is highest, at an average rate of 1 to 2 MGD (Brockton Water Department 2022a).

Table 6.1 Water Supply and Water Registration Information for the City of Brockton (MassDEP 2023a and 2023b)

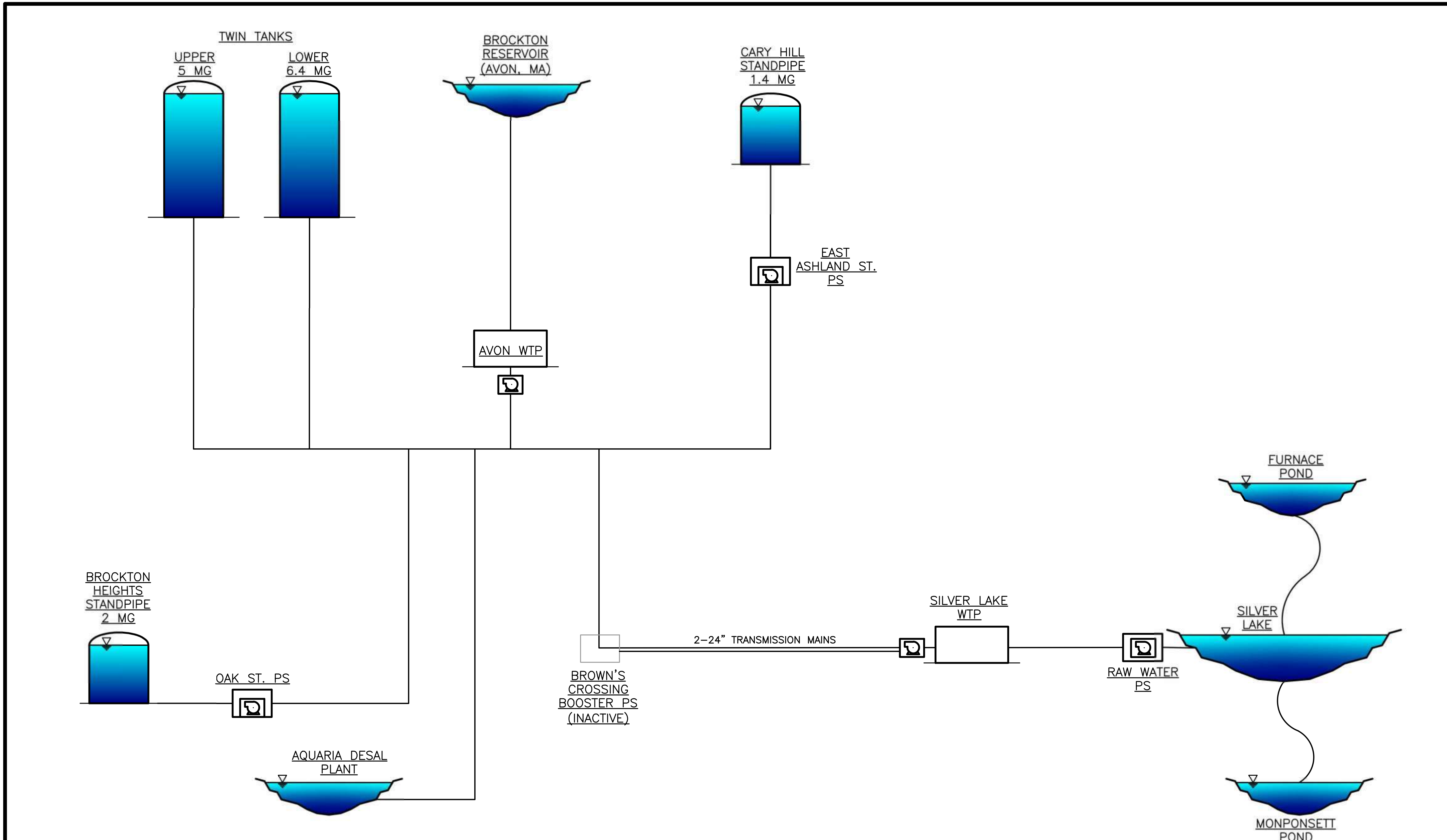
Basin Name	Drinking Water Source	Actual Average Daily Withdrawal (MGD) (Brockton Water Department 2022a)	Registered + Permitted[11] Daily Withdrawal (MGD)
South Coastal Basin	Silver Lake	8.11	11.11
	Furnace Pond		
	Monponsett Pond [1]		
Taunton River Basin	Hubbard Avenue Pump Station	0.0	0.04 + 0.83 = 0.87
	Brockton Reservoir [2]		
	Aquaria Desalination Plant	0.5	4.07
Total		8.61	16.05

Note:
[1] Monponsett Pond is in the Taunton River Basin, but it is included in the South Coastal Basin Registration.

[2] The water treatment associated with Brockton's Reservoir has been shut down since 2021 because of PFAS.

[11] Registered + Permitted: Registrations refer to established renewable water withdrawals established prior to 1988. Permitted withdrawals refer to WMA Permits issued for withdrawals beyond any registration amounts for ground or surface water sources in excess of an annual average of 100,000 gallons per day or 9 million gallons in any 3-month period.

Figure 6-1



CDM Smith

Figure 2-2
City of Brockton, Massachusetts
Water System Schematic
JULY 2017

The firm yield, or the average daily withdrawal from a water supply system that could theoretically be sustained through the drought of record (1964 to 1967) without entirely depleting the system storage, was determined in the 2007 *Firm Yield of Brockton Water Supply System* study. **Table 6.2** summarizes the firm yield.

Table 6.2 Firm Yield Summary (CDM Smith 2007)

	1964–1967	1980–1983
Silver Lake Firm Yield (MGD)	10.4	12.0
Brockton Reservoir Firm Yield (MGD)	0.9	1.1

6.1.1 Water Treatment

The City of Brockton has two active treatment facilities, listed in **Table 6.3**, to produce finished water.

Table 6.3 Treatment Plants and Capacities (Brockton Water Department 2022a)

Name	Capacity (MGD)
Silver Lake Water Treatment Plant	24
Woodland Avenue Water Treatment Plant	0.51

Note: [1]Plant recently could not run over 0.5 MGD because of organics in source water and current filtration.

The Woodland Avenue Water Treatment Plant (WTP) has been inactive since spring 2021 because of PFAS content in the Brockton Reservoir exceeding the MCL (Brockton Water Department 2022b).

6.1.2 Water Storage

The City of Brockton has four storage facilities in addition to the Brockton Reservoir, as shown in **Table 6.4**.

Table 6.4 Storage Tanks and Capacities (Brockton Water Department 2022a)

Name	Capacity (MG)	Storage Type
Twins Tank 1	6.4	Ground Level Storage Tank
Twins Tank 2	5	Ground Level Storage Tank
Irving Avenue Standpipe	2	Ground Level Storage Tank
Cary Hill Standpipe	1.4	Ground Level Storage Tank
Total	14.8	—

6.1.3 Water Distribution System

In 2021, 69% of the water was for residential use and 12% was for municipal use (Brockton Water Department 2022a). Additional details of the distribution system are included in **Table 6.5. Figure 6.2** shows a map of the hydraulic model used to represent the system, which corresponds to the service area.

Table 6.5 Details of Brockton's Distribution System (Brockton Water Department 2022a)

Distribution System Information	
Number of Service Connections	25,887
Number of Distribution Systems	3
Finished Water Storage Capacity (MG)	14.8
Total miles of Water Mains	315
Estimated Volume (MG) Lost to Leaks	30

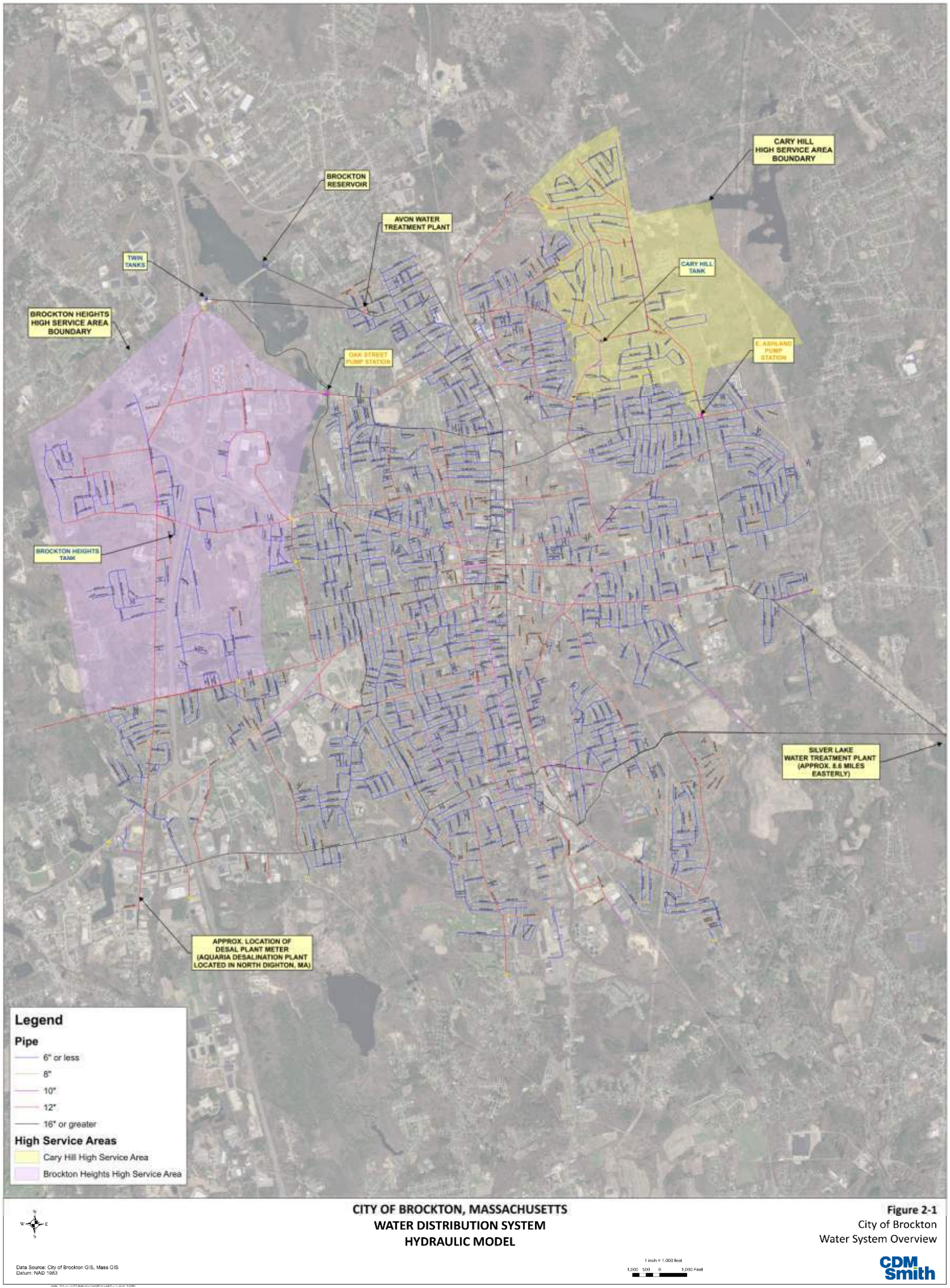


Figure 6.2 Map of Brockton's Water Distribution System

6.1.4 Interconnections

Brockton sells water to several surrounding communities and users, including East Bridgewater, Hanson, Whitman, Abington, Pembroke, the VA Boston Health Care system in Brockton, and the Gables housing development in Abington. **Table 6.6** provides the specific volumes sold in MG for 2019, 2021, and 2022.

Table 6.6 Summary of Water Sold (Million Gallons) (Brockton Water Department 2019, 2021a, 2022a)

Community	2019	2021	2022
East Bridgewater Water Department	2.045	—	0.137
Hanson Water Department	4.931	7.512	6.852
Whitman Water System	349.770	305.93	*311158
VA Boston Healthcare System Brockton	24.090	15.45	2.77
Abington	7.925	—	—
Pembroke	6.378	—	—
Gables Housing Abington Water	—	—	6.780

*Brockton reports selling 3.484MG of finished water to Whitman in their 2022 ASR. Whitman reports purchasing 311.158MG from Brockton in their ASR

The subsequent list are the communities with interconnections to the Brockton water system:

- Abington
- East Bridgewater
- Hanson
- Halifax
- Pembroke
- Whitman
- Avon
- Stoughton
- West Bridgewater

6.1.5 Private Wells

CDM Smith has not received data related to private well use within Brockton. However, due to a historic connection moratorium, there are numerous private wells in Brockton.

6.2 Water Demand

In the 2022 ASR, it was estimated that Brockton's water department was serving 105,643 residents, with an estimated 24 gallons per person per day. Additional information related to Brockton's 2022 demand is included in **Table 6.7**. In the 2009 Comprehensive Water Master Plan, there were projections of the average day demand for 2020 at 12 MGD, which would exceed the withdrawal limit (CDM Smith 2009). However, as seen from **Table 6.7**, the current demand has not reached this threshold.

Table 6.7 2022 Demand Information for Brockton (Brockton Water Department 2022a)

2022 Demand Information for Brockton	
MDD (raw)	10.44 MGD
ADD (raw)	8.61 MGD
UAW	10.7%
RGPCD	24 gallons/person/day

Note: Red text = violation

DCR's forecast projections were not provided for Brockton.

Seasonal water use restrictions were not provided for Brockton.

6.3 Issues and Concerns

6.3.1 Water Supply Issues

Aging Infrastructure

- One concern for Brockton's water supply is aging infrastructure, such as the transmission lines from Dighton and Silver Lake. The MVP recommended there be a comprehensive assessment of aging infrastructure (Fuss and O'Neill 2019).
  - The city did a Pure SmartBall assessment of the twin 24-inch cast iron transmission mains from the Silver Lake WTP, which showed the pipes were in good shape (Tighe & Bond 2020).
- According to the 2022 ASR, Brockton's 2022 UAW was 10.7%, exceeding the 10% standard.

Climate

- Drought was identified as one of the major hazards of concerns for Brockton in the MVP. This could lead to less surface water availability. Participants of the MVP Workshop expressed concern about the possibility of private wells running dry as a result of drought and the need to consider expanding the public water supply to provide a more resilient supply source for residents served by private wells (Fuss and O'Neill 2019).

6.3.1.1 Water Quality Issues

- In addition to droughts, other climate hazards related to water supply include increasing likelihood of harmful algal blooms and saltwater intrusion (Fuss and O'Neill 2019).
- Monponsett Pond has elevated concentrations of phosphorus due to legacy agricultural irrigation return flows, direct residential and commercial wastewater discharges and other sources such as stormwater. Monponsett Pond has suffered from cyanobacteria blooms which were likely exasperated by the removal of "nuisance" weeds in the late 1990s. Recent alum treatments have virtually eliminated significant cyanobacteria blooms. The Monponsett Watershed Association was formed in 2012 in Halifax to address concerns with the pond's condition. To date, most of their discussion has centered on the Brockton Water Department's use and control of East and West Monponsett Pond via a dam at the Stump Brook outlet and

diversions of water to Silver Lake in Kingston. Brockton is operating the system under an Administrative Consent Order meant to address water movement from Monponsett Pond.

Per- and Poly-Fluoroalkyl Substances

- **Table 6.8** includes results of sampling. The Woodland Avenue WTP has been inactive since spring 2021 because of PFAS content in the Brockton Reservoir exceeding the MCL (Brockton Water Department 2022b). The city is currently undergoing a filter rehab project, which includes removing and replacing all support gravel layers, fine sand media, and granular activated carbon (GAC) media in all six filters at the Silver Lake WTP. In addition, the existing clay block filter underdrains were cleaned and replaced, where necessary. While GAC media replacement was necessary because of the age of the existing GAC, the new GAC is Filtrasorb 300 by Calgon Carbon Corporation, which can eliminate PFAS contaminants for water treatment. The Silver Lake WTP filter project is expected to be complete by summer 2024.

Table 6.8 Six Per- and Poly-Fluoroalkyl Substances Results (Brockton Water Department 2021b)

Location of Sample	Date of Sample	Result (ppt)
Brockton Reservoir	11/18/2020	28
	1/12/2021	24
Silver Lake WTP	11/18/2020	2
	1/12/2021	3
	10/05/2022	2.91
	10/05/2023	2.48

Note: Red text = violation

- In September 2022, there were two total coliform positive samples on different days. In November 2022, there was one total coliform positive sample (Brockton Water Department 2022b).

6.4 Water Supply Alternatives

- The City of Brockton currently has a contract with the Aquaria Desalination plant. One alternative for water supply is to increase use of this water source. There have been ongoing discussions about different owners potentially purchasing the Aquaria Desalination plant, including the City of Brockton, but none of these plans are finalized at the moment.
- The City of Brockton is not currently pursuing any additional water supply sources, although the MVP made the recommendation of pursuing options for an additional backup water supply (Fuss and O'Neill 2019).
- In the 2017 Comprehensive Master Plan, the following infrastructure and utility recommendation was made: Brockton's Water Department should maintain and upgrade the water supply system to keep pace with current needs and future standards associated with comparable communities, including appropriate water rates. Further details were not included (Brockton Planning Board 2017).
- Addition of PFAS treatment to the Woodland Avenue WTP.

6.5 Questions

No Answers Provided

- Is the interconnections section correct? Are these one-way interconnections, two-way connections, or emergency connections? What is the capacity and source location for these? Is the water treated or raw? Are there any blending issues?
- Are there plans in place for additional emergency water supplies?
- Is there information on the number of residents on private wells? Are approximate locations available?
- Does Brockton Water Department have projections for future demand?
- Can you provide the city's historical population data and water use from 2000 to present?
- Can you provide any future population estimates if the city uses a different source than University of Massachusetts Donahue Institute's projections?
- What are the main nonresidential uses? Is it mainly commercial/industrial or municipal/institutional? Are there any projected increases or decreases in nonresidential demand?
- Does Brockton have a large seasonal population and/or tourism that impacts demands?
- Are projections available on the amount of units and timing associated the MBTA Community requirements? Are there estimates of water usage for these units?

6.6 References

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7.0 Duxbury

7.1 Water Supply

Duxbury has 12 groundwater source wells, each with its own pump station. Most of the town is serviced by these wells, except for Duxbury Beach and Gurney Road, which receive water through an interconnection to the Town of Marshfield (Town of Duxbury 2022a).

Duxbury's WMA Permit was issued in 2016. Nine of Duxbury's wells are registered. Four of the nine registered wells are also permitted, and three wells are permitted exclusively. The permit specifies a maximum authorized annual average withdrawal limit (**Table 7.1**) and maximum daily rates for some groundwater sources (**Table 7.2**). Additionally, Duxbury must continue monthly monitoring of North Hill Marsh Pond aquifer levels. If pond levels fall below 35.25 feet, then Duxbury must decrease withdrawals from the Mayflower Well 2 (MassDEP 2016).

The Partridge Street well went offline in 2021 because of high PFAS concentrations and the Depot Street Well has been offline since 2014 because of discoloration problems caused by iron and manganese (MassDEP 2016).

The total current operational rate of Duxbury's wells sources is approximately 3,185 gpm. This rate excludes Depot Well and Partridge well. Duxbury's current authorized average withdrawal under its WMA permit is 1,430.00 gpd. (Environmental Partners 2022).

Table 7.1 Duxbury's Maximum Authorized Annual Average Withdrawal Compared with 2023 Usage

	2023 ASR	WMA Permit #9P421082.01	
Drinking Water Source	Average Daily Withdrawal (MGD)	Registered + Permitted Withdrawal, 2020–2025 (MGD)	Registered + Permitted Withdrawal, 2025–2030 (MGD)
Systemwide	1.49	1.23 + 0.20 = 1.43	1.23 + 0.28 = 1.51

Note: Red text = violation

Table 7.2 Duxbury's Maximum Daily Withdrawal Rate Compared with 2023 Usage

	2023 ASR	WMA Permit #9P421082.01
Drinking Water Source	Maximum Daily Withdrawal (MGD)	Maximum Daily Rate (MGD)
Tremont Well 1 and 2	Well 1: 0.70 Well 2: 0.22	1.008
Evergreen Street Well 1	1.063	0.792
Evergreen Street Well 2		0.792
Mayflower Street Well 1	0.55	0.72
Mayflower Street Well 2	0.58	0.72

	2023 ASR	WMA Permit #9P421082.01
Damon Street Well 1	UNK	0.4
Damon Street Well 2	0.43	0.4
Lakeshore Drive Well	.4	0.504
Millbrook Pond Well	.368	0.5
Depot Street Well	offline	0.576
Partridge Road Well	offline	0.346

Note: Red text = violation

7.1.1 Water Treatment

Table 7.3 describes Duxbury's nine treatment facilities.

Table 7.3 Treatment Plants and Capacities (Town of Duxbury 2023a)

Name	Capacity (MGD)	Source	Treatment
Millbrook Pond Well Pumping Station	Not Listed	Millbrook Pond Well	Corrosion control, iron removal, fluoridation, disinfection
Partridge Road Well Pumping Station	Not Listed	Partridge Road Well	Corrosion control, disinfection, fluoridation
Deport Street Well Pumping Station	Not Listed	Depot Street Well	Corrosion control, fluoridation
Lake Shore Drive Well Pumping Station	Not Listed	Lake Shore Drive Well	Corrosion control, disinfection, fluoridation
Mayflower Well 1 Pumping Station	Not Listed	Mayflower Street Well 1	Corrosion control, disinfection, fluoridation
Mayflower Well 2 Pumping Station	Not Listed	Mayflower Street Well 2	Disinfection, fluoridation
Damon Wells Treatment Plant	1	Damon Wells 1 and 2	Fluoridation, corrosion control
Tremont Wells Treatment Plant	Not Listed	Tremont Wells 1 and 2	Corrosion control, iron removal, fluoridation, disinfection
Evergreen Treatment Plant	1.5	Evergreen Wells 1 and 2	Corrosion control, iron removal, fluoridation, disinfection

7.1.2 Storage

Table 7.4 summarizes Duxbury's storage tank capacity.

Table 7.4 Storage Tanks and Capacities (Town of Duxbury 2023a)

Name	Capacity (MG)	Storage Type
Captains Hill Tank	2	Ground Level Storage Tank
Birch Street Tank	1	Elevated Storage Tank
Total	3	—

7.1.3 Water Distribution System Information

Between 2012 and 2014, Duxbury has a UAW less than 2% (MassDEP 2016). Most of Duxbury's water usage (82%) is distributed for residential use (Town of Duxbury 2022a). **Table 7.5** provides information about the town's distribution system.

Table 7.5 Distribution System Information for the Town of Duxbury (Town of Duxbury, 2023a)

Distribution System Information	
Number of Service Connections	5,682
Number of Distribution Systems	2
Finished Water Storage Capacity (MG)	3
Pumping Capacity (gpm)	3,300
Total Miles of Water Mains	130
Estimated Volume (MG) Lost to Leaks	28000 (assumed gallons)

7.1.4 Interconnections

The Town purchases water from the Town of Marshfield to serve the Gurnet Road area. The Town of Marshfield uses a Master meter to record the volume of water served to the Gurnet road area and bill the Duxbury water department accordingly (Environmental Partners 2022). In 2023 Duxbury purchased 9.8 MG from Marshfield (Town of Duxbury, 2023a).

Duxbury also has one emergency piped connection with the Marshfield at Acorn Street, two emergency hydrant-to-hydrant connections with Pembroke at High Street and the intersection of Pine Street and Chapel Street, and two emergency hydrant-to-hydrant interconnections with Kingston at Winter Street and at South Street. There are no contractual agreements with any neighboring water systems, but the intent of using these interconnections is for the purpose of mutual aid (Environmental Partners 2022). Duxbury has not utilized emergency interconnections between towns in recent years (Cloud 2024).

7.1.5 Private Wells

A list of private wells is available online for Duxbury [12].

7.1 Water Demand

Table 7.6 provides details of the town's water demand for 2023. 82% of Duxbury's water use is residential (Town of Duxbury 2023a). The main non-residential use is restaurants (Cloud 2024). **Table 7.7** provides historical data.

Table 7.6 Water Demand Information for the Town of Duxbury

Demand Information	
MDD (raw)	0.69
ADD (raw)	1.49

[12] https://duxburysafewater.org/wp-content/uploads/2022/10/potable-wells-by-street-with-town-water-label-2022.pdf

Demand Information	
UAW	7.2 %
RGPCD	82 gallons/person/day

Notes: Red text = violation. MDD and ADD data comes from (Environmental Partners 2023a), while UAW comes from (MassDEP 2016). RGPCD comes from (Town of Duxbury 2022a).

Table 7.7 Duxbury's Historical Finished Water Demand 2015 to 2020 (Environmental Partners 2023a)

Year	MDD (MGD)	ADD (MGD)
2015	3.43	1.54
2016	3.70	1.60
2017	4.63	1.46
2018	3.81	1.52
2019	3.28	1.45
2020	3.56	1.74
Average	3.74	1.55

Figure 7.1 depicts Duxbury's historical annual withdrawals compared to the WMA-permitted withdrawal limits and two projection scenarios, presumably provided by the Massachusetts DCR. The red line represents what Duxbury's water demand will look like if they continue to have high RGPCD over 85 gallons per person per day and the blue lines represents Duxbury's predicted demand if they maintain the performance standard RGPCD of 65 gallons per person per day *(*Environmental Partners 2023a).

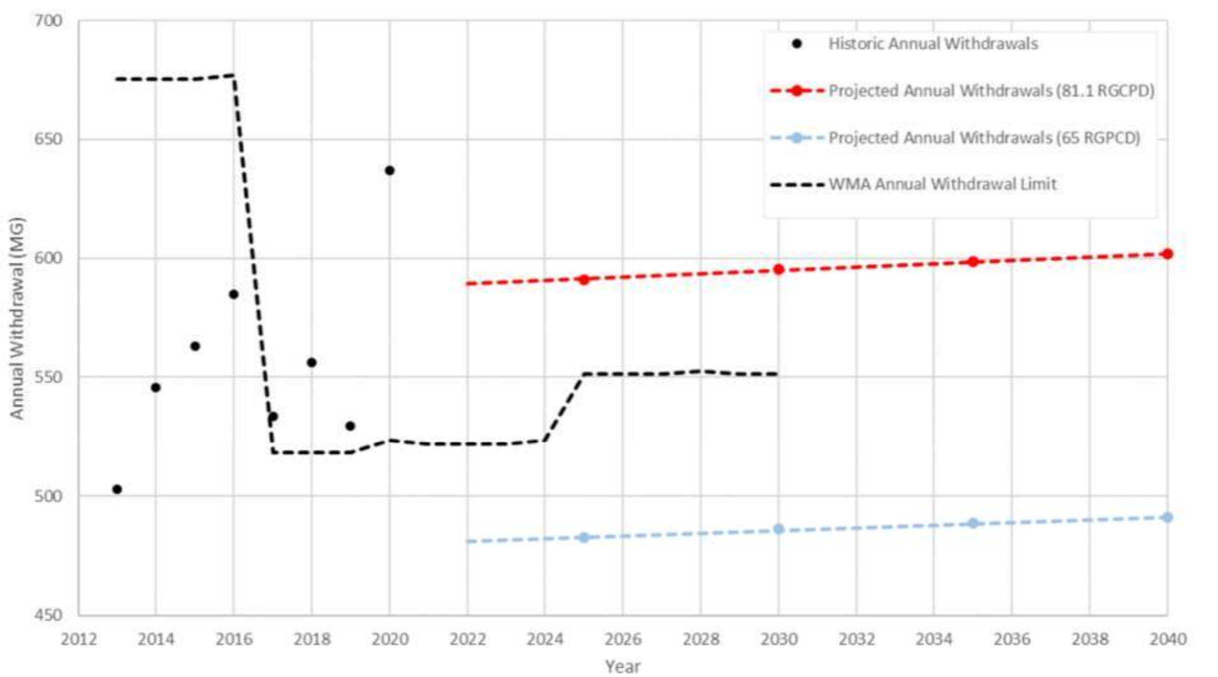

Figure 7.1 Water Demand Forecast *(*Environmental Partners 2023a)

In 2023, there was a mandatory watering restriction from May to September. Odd-numbered houses were restricted on Tuesday, Thursday, and Saturday. Even-numbered houses were restricted Monday, Wednesday, and Friday. All outdoor watering had to be done between 4 to 8 a.m. and 5 to 9 p.m. There was no watering on Sunday. Rain sensors were required to be installed and used on all irrigation systems (Town of Duxbury 2023b).

7.2 Issues and Concerns

7.2.1 Water Supply Issues

- Duxbury's wells are vulnerable to scarcity during periods of drought, aquifer salinization from sea level rise, and well infrastructure damage/salinization from coastal flooding and sea level rise (Metropolitan Area Planning Council [MAPC] 2018).
- In 2020 and 2023, Duxbury's ADD and RGPCD exceeded the permitted withdrawal limits (Town of Duxbury 2023a,2023b).

7.2.1.1 Water Quality Issues

- Duxbury is entirely dependent on groundwater for its drinking water supply, and preventing contamination of the groundwater is a constant challenge for the town. Duxbury's contaminant threats include sewage waste, herbicides, and fertilizers. There is great concern that sizable new residential subdivisions will impact the drinking water supplies. While most of the town uses septic systems, Duxbury has three wastewater treatments plants, all whose leaching fields are located within a 1% annual chance flood zone, and the flood risk increases greatly with sea level rise in 2038 and 2088 (MAPC 2018).
- The maximum concentration for manganese detected in drinking water in 2022 was 0.12[13] ppb, which exceeds the MassDEP and U.S. Environmental Protection Agency (EPA) SMCL of 0.05 ppb (Town of Duxbury 2022a).

Per- and Poly-Fluoroalkyl Substances

- Duxbury has a regular sampling program for PFAS, as shown in **Table 7.8**.

Table 7.8 Per- and Poly-Fluoroalkyl Substances Sampling Result for the Town of Duxbury (Environmental Partners 2023b)

PFAS6 Compliance Sampling Results

Source	4/28/2021	5/20/2021	6/15/2021	10/20/2021	1/24/2022	2/8/2022	9/20/2022	1/24/2023	4/25/2023	7/2/2023
Millbrook Well	-	6.56	-	3.67	5.93	-	7.04	6.46	-	6.49
Partridge Well	75.93	5.10	105.21	-	83.15	-	56.90	72.70	71.01	not tested
Depot Well	10.40	0.86	-	11.96	14.88	-	11.40	7.57	6.90	not tested
Lakeshore Well	6.43	6.56	-	8.60	8.97	-	2.56	6.45	-	6.67
Tremont Wells No. 1 and 2	0.0000	-	-	0.72	0.00	0.00	0.00	0.00	-	2.12
Evergreen Wells No. 1 and 2	1.88	0.00	-	3.85	4.39	-	2.27	0.00	-	2.00
Mayflower Wells No. 1 and 2	4.11	4.50	-	2.80	6.26	-	2.17	4.58	-	4.85
Damon Wells No. 1 and 2	6.48	7.66	-	6.39	7.83	-	6.71	7.24	-	6.16

* PFAS6 summation excludes compound levels below the Method Reporting Level (MRL) for the compound

[13] Red text = violation

- PFAS concentration in drinking water was 83.2 ppt according to the 2022 Annual Water Quality Report.
- Beginning in 2021, high PFAS concentrations were found in the Partridge Well, with samples ranging from 56.90 to 105.21 ppt. After testing, the town shut down the well and MassDEP requested PFAS sampling at the Duxbury Municipal Landfill. All wells at the Duxbury Municipal Landfill tested above the drinking level standards for PFAS in 2022. The test results for the Partridge Well, as listed in **Table 7.8**, continue to exceed the MCL.
- Duxbury currently has Environmental Partners working on a prioritization plan to install treatment at the wells (Cloud 2024).

7.2.2 Water Demand Issue

- Historically, Duxbury has been exceeding 65 RGPCD. In 2023, the average gallons per day per person was 82 gallons (Town of Duxbury 2023a), exceeding the standard.

7.2.3 Other Issues

- Duxbury has over 1,200 acres of salt marsh meadows providing critical shoreline protection. The majority are healthy, intact ecosystems except for the Bay Farm marsh, which is showing signs of degradation and erosion. However, since 1995, Duxbury has experienced 1,000-acre loss of eelgrass meadow, an important natural shoreline protection system (MAPC 2018).

7.3 Water Supply Alternatives

- An action item for Duxbury set out in their master plan is the monitoring of nitrogen loads and contamination in groundwater and the development of a townwide stormwater management bylaw (MAPC 2019).
- An action item for Duxbury set out in their master plan is land acquisition efforts to protect surface water, groundwater, and wildlife coordinates (MAPC 2019).
- Financing for engineering design for the treatment of Partridge Well was approved during the town meeting in March 2023. Investigating sources of PFAS including former Duxbury Landfill Inc. and Duxbury Municipal Landfill (Town of Duxbury 2024).
- Metals and PFAS treatment project beginning for Depot Well and Tremont wells (Environmental Partners 2023b).
- Future PFAS projects and mock-up time line for the other wells outlined in PFAS update (Environmental Partners 2023b).
- A Draft Master Plan and Water Quality Study, prepared by Environmental Partners, LLC was completed and submitted to the town in June 2022. The draft plan includes a description of the town’s water distribution system, the town’s supply and demand needs, storage, distribution system modeling, and assessment as well as water quality and future capital improvement needs (Town of Duxbury 2022b).
- Duxbury is limited by its well pumping capacity (Environmental Partners 2023a).

7.4 Questions

Answers from email sent by Mark Cloud on April 25, 2024 are shown in blue.

- The approved pumping volume for Tremont Well 1 was listed as 0 in 2020 ASR even though it is an active well. Is there a reason? ASR has totals – Attached.
- Can we access the Water Quality Study prepared by Environmental Partners, LLC and completed in 2022? Yes.
- Do you have a filled-out ASR? Looking for information on recent RGPCD and UAW. Attached
- Has Duxbury made any changes since 2020 from their Water System Master Plan? For example, is the PFAS treatment system complete or has the pump capacity increased? We have EP working on a prioritization plan to install treatment at our wells.
- Is the interconnections section correct? Are these one-way interconnections, two-way connections, or emergency connections? What is the capacity and source location for these? Is the water treated or raw? Are there any blending issues? We have not utilized these connections.
- Are there plans in place for additional emergency water supplies? No
- Does Duxbury have projections for future demand? In Master Plan
- What are the main nonresidential uses? Restaurants Is it mainly commercial/industrial or municipal/institutional? Residential Are there any projected increases or decreases in nonresidential demand? No

7.5 References

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8.0 East Bridgewater

8.1 Water Supply

The Town of East Bridgewater has five groundwater wells within the Taunton River Basin and relies 100% on groundwater. Four of the wells are in the eastern section of town and are connected to the Crescent Street Treatment Plant. The fifth well is in the Elmwood section of town and is connected to the East Street Treatment Plant (Town of East Bridgewater 2022).

East Bridgwater's current WMA Permit was renewed on March 17, 2021. The permit specifies a maximum authorized annual average withdrawal limit, shown in **Table 8.1**, and maximum daily withdrawal rate for each well, shown in **Table 8.2**.

Table 8.1 East Bridgewater's Maximum Authorized Annual Average Withdrawal Compared with 2021 Usage

	2021 ASR	WMA Permit #9P-4-25-083.01
Drinking Water Source	Average Daily Withdrawal (MGD)	Registered + Permitted[14] Withdrawal, 2020–2030 (MGD)
Taunton River Basin	0.88	0.85 + 0.36 = 1.21

Table 8.2 East Bridgewater's Maximum Daily Withdrawal Rate Compared with 2021 Usage

	2021 ASR	WMA Permit #9P-4-25-083.01
Drinking Water Source	Maximum Daily Withdrawal (MGD)	Maximum Daily Rate (MGD)
Well 1	0.157	0.72
Well 2	0.32	0.63
Well 3	0.12	0.42
Well 4	0.362	0.72
Well 5	0.606	0.94

8.1.1 Water Treatment

Table 8.3 provides details on East Bridgewater's two treatment plants.

[14] Registered + Permitted: Registrations refer to established renewable water withdrawals established prior to 1988. Permitted withdrawals refer to WMA Permits issued for withdrawals beyond any registration amounts for ground or surface water sources in excess of an annual average of 100,000 gallons per day or 9 million gallons in any 3-month period.

Table 8.3 Treatment Plants and Capacities (Town of East Bridgewater 2021)

Name	Capacity (MGD)	Source	Treatment
Crescent Street Treatment Plant	2.02	Wells 1, 2, 3, and 4	Disinfection, corrosion control, iron removal
East Street Treatment Plant	0.86	Well 5	Disinfection, corrosion control, iron removal

8.1.2 Water Storage

Table 8.4 summarizes East Bridgewater's storage capacity.

Table 8.4 Storage Tanks and Capacities (Town of East Bridgewater 2021)

Name	Capacity (MG)	Storage Type
Highland Street Storage Tank	1.5	Elevated Storage Tank

8.1.3 Water Distribution System

In 2022, 90% of East Bridgwater's water went towards residential use (Town of Bridgewater 2021). Information about the East Bridgewater's distribution system can be found in **Table 8.5**.

Table 8.5 Distribution System Information for the Town of East Bridgewater

Distribution System Information (Town of East Bridgewater 2021)	
Number of Service Connections	4,448
Number of Distribution Systems	1
Finished Water Storage Capacity (MG)	1.5
Pumping Capacity (gpm)	2,150
Total Miles of Water Mains	113
estimated Volume (MG) Lost to Leaks	0

8.1.4 Interconnections

East Bridgewater has the following interconnections in case of emergency (Town of East Bridgewater 2022):

- Brockton
- Bridgewater
- Halifax
- Hanson
- Whitman

8.1.5 Private Wells

East Bridgewater has 25 private potable wells. There are approximately 175 irrigation wells scattered around town.

There are two areas in East Bridgewater that have well moratoriums- Plymouth Street, Bridge Street and West Pond Street that are adjacent to a capped landfill (877 Bridge Street) and the area within a 0.5 mile radius of 100 Industrial Drive, a hazardous waste site (DEP RTN 4-0028937). (Joyce, Jeanmarie Kent, 2024)

8.2 Water Demand

Table 8.6 provides water demand details from 2021.

Table 8.6 Water Demand Information for the Town of East Bridgewater (Town of East Bridgewater 2021)

2021 Demand Information	
MDD (raw)	1.315 MGD
ADD (raw)	0.88 MGD
UAW	2.2%
RGPCD	48 gallons/person/day

In 2014, approximately 3.01 MG of water was purchased from Whitman and Brockton during an emergency water shortage (Environmental Partners 2020).

DCR's water needs forecast calculates a water demand of 1.45 MGD from 2020 to 2025 and 1.49 MGD from 2025 to 2030 based on current trends in RGPCD and UAW (MassDEP 2021). Alternatively, East Bridgewater's Water System Master Plan estimates that the demand for raw water will be 1.09 MGD by 2035 (Environmental Partners 2020).

The town renewed their WMA Permit with no additional withdrawals proposed for the next 20-year permit cycle (Environmental Partners 2020). Seasonal water use restrictions are implemented in the Town of East Bridgewater.

8.3 Issues and Concerns

8.3.1 Water Supply Issues

- If East Bridgewater's largest well, Well 5, were to becomes contaminated and/or go offline, they would struggle to meet peak demand (Environmental Partners 2020).

8.3.1.1 Water Quality Issues

- In 2021, the town reported sodium concentrations between 30.7 and 53.5 ppm, which are above the Massachusetts ORSG of 20 ppm. One acetone concentration was 18.8 milligrams per liter (mg/L), which is above the acetone ORSG of 5 mg/L. In 2015, East Bridgwater reported an odor of 5 TON, which above the SMCL. It does not appear that the town has sampled odor again since 2015 (Town of East Bridgewater 2022).

Per- and Poly-Fluoroalkyl Substances

- In 2022, the town reported a PFAS6 drinking water concentration of 5.53 ppt, which does not exceed the current standard (Town of East Bridgewater 2022).

8.3.2 Water Demand Issues

- East Bridgewater does not have water demand issues.

8.3.3 Other Issues

- East Bridgewater is seeking to evaluate and restore Forge Pond and Robbins Pond (Environmental Partners 2021).

8.4 Water Supply Alternatives

- East Bridgewater's Water System Master Plan recommends developing a satellite well by Well 5 because if Well 5 was to go offline, the town would not be able to meet future maximum day demands (Environmental Partners 2020). Doing so would increase overall system resiliency but would not increase the potential amount of raw water available because of capacity limitations of the East Street Treatment Plant. The plan also recommends that East Bridgewater rehabilitate the existing emergency interconnections with Brockton at both Winter Street and Central Street to be permanent interconnections. This would be an important asset if Well 5 becomes contaminated.

8.5 Questions

No Answers Provided

- Is the interconnections section correct? Are these one-way interconnections, two-way connections, or emergency connections? What is the capacity and source location for these? Is the water treated or raw? Are there any blending issues?
- Are there plans in place for additional emergency water supplies?
- Is there information on the number of residents on private wells? Are approximate locations available?
- Does East Bridgewater have projections for future demand?
- Can you provide the town's historical population data and water use from 2000 to present?
- Can you provide any future population estimates if the town uses a different source than University of Massachusetts Donahue Institute's projections?
- What are the main nonresidential uses? Is it mainly commercial/industrial or municipal/institutional? Are there any projected increases or decreases in nonresidential demand?
- Are projections available on the amount of units and timing associated the MBTA Community requirements? Are there estimates of water usage for these units?

8.6 References

Environmental Partners. 2021. Municipal Vulnerability Preparedness Program.

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Town of East Bridgewater. 2022. Annual Drinking Water Quality Report.

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9.0 Easton

9.1 Water Supply

Easton relies on six gravel-packed groundwater wells and one wellfield. The wells are located throughout the town and pump between 325 and 1,000 gpm (Easton Water Division 2023a

Easton's WMA Permit was renewed on Feb 15, 2020 and specifies a maximum authorized annual average withdrawal limit (**Table 9.1**) and maximum daily withdrawal rates for each well (**Table 9.2**).

Table 9.1 Easton's Maximum Authorized Annual Average Withdrawal Compared with 2022 Usage

	2022 ASR	WMA Permit #9P-4-25-088.01	
Drinking Water Source	Average Daily Withdrawal (MGD)	Registered + Permitted[15] Withdrawal, 2020–2025 (MGD)	Registered + Permitted Withdrawal, 2025–2030 (MGD)
Taunton River Basin	1.79	1.44 + 0.77 = 2.21	1.44 + 0.92 = 2.36

Table 9.2 Easton's Maximum Daily Withdrawal Rate Compared with 2022 Usage

	2022 ASR	WMA Permit #9P-4-25-088.01
Drinking Water Source	Maximum Daily Withdrawal (MGD)	Maximum Daily Rate (MGD)
Station 1	0.608	1.08
Station 2	1.28	1.44
Station 3	0.466	0.5
Station 4R	0.746	1.22
Station 5	0.329	0.72
Station 6	0.491	0.5
Station 7	0.46	0.47

9.1.1 Water Treatment

Table 9.3 provides details for Easton's nine WTPs.

[15] Registered + Permitted: Registrations refer to established renewable water withdrawals established prior to 1988. Permitted withdrawals refer to WMA Permits issued for withdrawals beyond any registration amounts for ground or surface water sources in excess of an annual average of 100,000 gallons per day or 9 million gallons in any 3-month period.

Table 9.3 Treatment Plants and Capacities (Easton Water Division 2022)

Name	Capacity (MGD)	Source	Treatment
Well 4R Pumping Station	1.22	Well 4R	PFAS removal, corrosion control, disinfection
Well 1 Pumping Station	1.08	Well 1	PFAS removal, corrosion control, disinfection
Well 2 Pumping Station	1.44	Well 2	PFAS removal, corrosion control, disinfection
Well 3 Pumping Station	0.5	Well 3	Corrosion control, disinfection
Well 5 Pumping Station	0.72	Well 5	Corrosion control, disinfection
Well 6 Pumping Station	0.5	Well 6	Corrosion control, disinfection
Well 7 Pumping Station	0.47	Well 7	Corrosion control, disinfection
Red Mill Road Filtration Plant (online in 2024)	2.07	Wells 3, 5, and 7	Iron and manganese and PFAS in the future

9.1.2 Water Storage

Table 9.4 summarizes Easton's storage capacity.

Table 9.4 Storage Tanks and Capacities (Easton Water Division 2022)

Name	Capacity (MG)	Storage Type
Washington Street Tank	2	Ground Level Storage Tank
Bay Road Tank	2	Ground Level Storage Tank
Total	4	—

9.1.3 Water Distribution System

Eighty-eight percent of Easton's water is distributed for residential use and ~9% goes towards commercial/business use (Easton Water Division 2022). Easton provides water to six to eight homes in the Town of West Bridgewater and one home in the Town of Stoughton (Easton Water Division 2023b). **Table 9.5** provides information about the town's water distribution system.

Table 9.5 Distribution System Information for the Town of Easton (Easton Water Division 2022)

Distribution System Information	
Number of Service Connections	7,612
Number of Distribution Systems	1
Finished water Storage Capacity (MG)	4
Pumping Capacity (gpm)	4,275
Total Miles of Water Mains	170
Estimated Volume (MG) Lost to Leaks	N/A

9.1.4 Interconnections

In 2022, Easton sold water to Stoughton Water Department (30,720 gallons), Bluedrop (76,847 gallons), West Bridgewater (658,164 gallons), Norton (136,632 gallons), and Mansfield (110,415 gallons) (Easton Water Division 2022).

According to Gregory Swan, "The Town of Easton is not interconnected with any surrounding towns." (Swan 2024).

9.1.5 Private Wells

CDM Smith received a list of private wells in Easton (Swan 2024).

9.2 Water Demand

Table 9.6 provides water demand details from 2022, and **Table 9.7** provides historical water demand comparisons from 2015 to 2022.

Table 9.6 Water Demand Information for the Town of Easton

Demand Information (2022 ASR)	
MDD (raw)	3.18 MGD
ADD (raw)	1.79 MGD
UAW	9.3%
RGPCD	56.65 gallons/person/day

Table 9.7 Historical Water Demand (2015 to 2022) (Easton Water Division 2023b)

PWSID	#Sources	% Ground	%Purch Ground	% SURFACE	%Purch Surface	YEAR	Avg Daily Demand (MGD)	Max Daily Demand (MG)
4088000	8	100	0	0	0	2022	1.797	3.185
4088000	8	100	0	0	0	2021	1.719	2.756
4088000	8	100	0	0	0	2020	1.995	4.045
4088000	8	100	0	0	0	2019	1.927	3.252
4088000	8	100	0	0	0	2018	1.926	3.709
4088000	8	100	0	0	0	2017	1.775	3.775
4088000	8	100	0	0	0	2016	1.953	3.858
4088000	8	100	0	0	0	2015	1.888	3.621

Based on compliance with the performance standards of 65 RGPCD and 10% UAW, DCR's forecast calculates an average daily water demand of 2.21 MGD from 2020 to 2025 and 2.36 from 2025 to 2030 based on current trends in RGPCD and UAW (MassDEP 2020).

In accordance with their WMP, Easton has implemented two levels of water restrictions. Phase II is a lighter restriction than Phase III. The phase is determined by the preceding years' ability to reach the RGPCD standard of 65 MGD and/or streamflow triggers. The streamflow-triggered restriction is based on USGS Stream Gage 01108000 at Taunton River near Bridgewater (Easton Water Division 2022). Based on the permit, Easton must enforce an outdoor watering restriction when streamflow drops below either 265 cfs in May to June or 119 cfs in July to September. In 2022, the Phase III restriction was in effect from May 1st to November 1st. Sprinkler and irrigation systems could only be used by even-numbered addresses on Monday and odd-numbered addresses on Tuesday.

9.3 Issues and Concerns

9.3.1 Water Supply Issues

- Droughts in the three aquifers, including the Canoe River Aquifer, was cited as a concern in Easton's MVP workshop (RTWN 2018).

9.3.1.1 Water Quality Issues

Per- and Poly-Fluoroalkyl Substances

The town identified Wells 1, 2, and 4R as the major contributors to PFAS in the drinking water, as listed in **Table 9.8**, which provides PFAS6 sample results from 2019 to 2021. **Table 9.9** provides a breakdown of PFAS6 in the town's drinking water. The town responded to these sampling results by constructing three PFAS treatment plants for these three wells, which went online in 2023.

Table 9.8 Per- and Poly-Fluoroalkyl Substances Level by Water Source Prior to Construction of Per- and Poly-Fluoroalkyl Substances Removal Treatment Plants (Easton Water Division n.d)

	US EPA Health Advisory of 70 ppt in effect									MassDEP MCL of 20 ppt in effect						
	2019 samples, ppt					2020 samples, ppt				2021 samples, ppt						
	Initial First Year Data Collection									Initial	Confirmatory	PE/PN	2nd QTR		3rd QTR	
Well:	May	July	Sept.	Oct.	Dec.	Jan	April	August	Oct.	Jan.	February	March	April	June	July	August
Well #1			51.5	38.7		39.1	40.7	58.0	31.4	31.2 J	31.4 J	38.9	34.9	36.5	35.8	41.3
Well #2			27.2	10.0			9.5	25.9	14.4	9.45 J	8.83 J		12.4		21.7	30.0
Well #3			11.3		5.1								12.3		12.9	9.1
Well #4	15.6	26.7	28.2			29.7	23.0	29.9	19.5	27.1 J	24.8 J	30.1	24.2	19.2	27.9	18.8
Well #5			14.3		6.6		13.3	16.0	16.8	12.6 J	14.6 J	19.2	17.6	15.5	16.6	14.0
Well #6			ND												ND	
Well #7			8.0		5.4								10.8		8.5	

Table 9.9 Breakdown of Per- and Poly-Fluoroalkyl Substances in Drinking Water (Easton Water Division 2023a)

2022 PFAS in Drinking Water (ppt)	
PFHpA	6.12
PFHxS	12.6
PFOS	28.4
PFOA	15.2

Note: PFHpA = Perfluoroheptanoic acid; PFHxS = Perfluorohexane sulfonate; PFOS = Perfluorooctane sulfonic acid; PFOA = Perfluorooctanoic acid

As of 2023, Easton was seeing concentrations of PFAS6 over the MassDEP standard in their drinking water. **Table 9.10** provides quarterly average of PFAS6 for Quarter 3 of 2023.

Table 9.10 2023 PFAS Sampling Results (Easton Water Division 2023a)

Well	PFAS6 Quarterly Average (Quarter 3, 2023) (ppt)
Station 1	38
Station 2	18 (filter plant went online during this quarter)
Station 4R	22
Station 3, 5, 6, and 7	9.94–16.8

Note: Red text = violation

As of December 2024, all three filter plants are operational to filter out PFAS to a level of non-detection for Wells 1, 2, and 4R.

There are plans for the new Red Mill Road Filtration Plant to treat PFAS at wells 3, 5, and 7 (Swan 2024).

9.3.2 Other Issues

- Easton has expressed concerns about two dams that have been breached in the past at Flyaway Pond and Monte Pond (RTWN 2018).
- Nitrification of groundwater and decline in water quality from septic systems were listed as concerns in Easton's MVP workshop (RTWN 2018).

9.4 Water Supply Alternatives

- Historically, Easton has a high ratio of summer to winter usage, up to 70% higher. Therefore, Easton is required to document a program to increase participation and compliance with outdoor water use restrictions. At the next WMA permit review, Easton will be required to report on its outreach and enforcement efforts (MassDEP 2020).

9.5 Questions

Questioned answered by Gregory Swan on 4/30/2024 shown in blue.

- Is the new Red Mill Road Filtration Plant the same facility as Well 7 Pumping Station? No. The RMR WTP treats wells 3, 5 and 7 for Iron and Manganese. It will treat for PFAS in the near future.
- Is the interconnections section correct? Are these one-way interconnections, two-way connections, or emergency connections? What is the capacity and source location for these? Is the water treated or raw? Are there any blending issues? The Town of Easton is not physically interconnected with any surrounding towns.
- Are there plans in place for additional emergency water supplies? Yes, the town of Easton has an emergency plan for water.
- Does Easton have projections for future demand? No
- Can you provide the town's historical population data and water use from 2000 to present?

2000 22,299

2010 23,112

2020 25,058

2022 is estimated at 25,240

- Can you provide any future population estimates if the town uses a different source than University of Massachusetts Donahue Institute's projections? No
- What are the main nonresidential uses? Is it mainly commercial/industrial or municipal/institutional?

COMMERCIAL ACCOUNTS – 297

SPRINKLER ACCOUNTS – 211

RESIDENTIAL ACCOUNTS – 7339

HOUSE OF WORSHIP AND EDUCATIONAL ACCOUNTS - 62

AGRICULTURAL ACCOUNTS – 8

MUNICIPAL ACCOUNTS - 45

TOTAL ACTIVE SERVICE ACCOUNTS – 7,962

- Are there any projected increases or decreases in nonresidential demand? Are projections available on the amount of units and timing associated the MBTA Community requirements? Are there estimates of water usage for these units? No

9.6 References

Easton Water Division. 2023a. Annual Water Quality Report.

———. 2023b. Sanitary Survey Report.

———. 2022. Annual Statistics Report.

———. n.d. https://www.easton.ma.us/departments/dpw/water_division/pfas_information.php

Massachusetts Department of Environmental Protection (MassDEP). 2020. WMA Permit #9P-4-25-088.01.

Resilient Taunton Watershed Network (RTWN). 2018. Municipal Vulnerability Preparedness and Community Resilience Workshop Summary of Findings.

Swan, Gregory. 2024. Email Response to Questions.

10.0 Halifax

Halifax draws water from four wells at two groundwater sites: the Richmond Park Well site and the Young Men's Christian Association (YMCA) camp site. Richmond Park Wells 1 and 2 were constructed in 1965 and 1972, respectively. Both Richmond Park wells are registered and permitted. The YMCA Wells 3 and 4 were constructed in 1990 and 2004, respectively. Wells 3 and 4 are permitted but are not registered (Halifax Water Division 2022b).

Halifax's current WMA Permit was renewed on January 5, 2021 and specifies a maximum authorized annual average withdrawal limit (**Table 10.1**) and maximum daily withdrawal rates for each well (**Table 10.2**). Halifax is impacted by the mitigation condition of the WMA Permit. Halifax's baseline withdrawal from the Taunton River Basin is 0.54 MGD (average withdrawal from 2003 through 2005 plus 5%). Halifax is responsible for a mitigation volume of 0.14 MGD (baseline basin withdrawal subtracted from authorized basin withdrawal). However, since Halifax is handled by septic systems or permitted groundwater discharges, it is assumed that 85% of the water withdrawn is returned to the basin via groundwater returns. Therefore, Halifax is only responsible for 15% of the 0.14 MGD mitigation volume. The purchase of a 17.65-acre property for conservation grants Halifax enough credits to fulfill this requirement (MassDEP 2021).

Table 10.1 Halifax's Maximum Authorized Annual Average Withdrawal Compared with 2022 Usage

	2022 ASR	WMA Permit #9P-4-25-118.01
Drinking Water Source	Average Daily Withdrawal (MGD)	Registered + Permitted[16] Withdrawal, 2020–2030 (MGD)
Taunton River Basin	0.48	0.33 + 0.35 = 0.68

Table 10.2 Halifax's Maximum Daily Withdrawal Rate Compared with 2022 Usage

	2022 ASR	WMA Permit #9P-4-25-118.01
Drinking Water Source	Maximum Daily Withdrawal (MGD)	Maximum Daily Rate (MGD)
Richmond Park Well 1	0.261	0.31
Richmond Park Well 2	0.368	0.643
YMCA Well 3	0.44	1.001
YMCA Well 4	0.509	1.01

Note: DEP approved maximum daily rates listed in Halifax's ASR differ from those stated in their WMA permit

Well 3 is an alternative supply to other approved sources. YMCA Well 3 can never be operated simultaneously with YMCA Well 4 (MassDEP 2021).

[16] Registered + Permitted: Registrations refer to established renewable water withdrawals established prior to 1988. Permitted withdrawals refer to WMA Permits issued for withdrawals beyond any registration amounts for ground or surface water sources in excess of an annual average of 100,000 gallons per day or 9 million gallons in any 3-month period.

10.1 Water Supply

10.1.1 Water Treatment

Table 10.3 describes Halifax's two treatment plants.

Table 10.3 Treatment Plants and Capacities (Halifax Water Department 2022a)

Name	Capacity (MGD)	Source	Treatment
Richmond Park Iron Removal Plant	1	Richmond Park wells	Corrosion control, disinfection, iron removal, manganese removal
YMCA Wells Treatment Plant	1	YMCA wells	Corrosion control, disinfection

10.1.2 Water Storage

Halifax operates one storage tank that was built in 1960, rehabilitated in 2015, and fully cleaned in 2021 (Halifax Water Department 2022b). **Table 10.4** summarizes Halifax's storage capacity.

Table 10.4 Storage Tanks and Capacities (Halifax Water Department 2022a)

Name	Capacity (MG)	Storage Type
Storage Tank	0.5	Elevated Storage Tank

10.1.3 Water Distribution System

In 2022, 70% of Halifax's water was distributed to residential areas, 20% went to commercial/business areas, and 10% went to municipal/institution/non-profit areas (Halifax Water Department 2022a). **Table 10.5** provides additional information about the Halifax's distribution system.

Table 10.5 Distribution System Information for the Town of Easton (Halifax Water Department 2022a)

Distribution System Information	
Number of Service Connections	2,871
Number of Distribution Systems	1
Finished Water Storage Capacity (MG)	0.5
Pumping Capacity (gpm)	900
Total Miles of Water Mains	51
Estimated Volume (MG) Lost to Leaks	Not reported

10.1.4 Interconnections

A handful of homes in Pembroke are supplied by Halifax. However, they do not have a connection with the Town of Pembroke's Water System. (Lindsey 2024).

Halifax has the option to purchase water from Brockton as a backup supply (Halifax Water Department 2022a).

10.1.5 Private Wells

CDM Smith received a rough estimate that around 25% or less of residence are on private wells (Lindsey 2024)

10.2 Water Demand

Table 10.6 provides details related to water demand from 2022.

Table 10.6 Water Demand Information for the Town of Easton (Halifax Water Department 2022a)

2022 Demand Information	
MDD (raw)	0.777 MGD
ADD (raw)	0.48 MGD
UAW	6.7%
RGPCD	50 gallons/person/day

DCR's water needs forecast projects a daily average water demand of 0.61 MGD for 2021 to 2025 and 0.62 from 2026 to 2030, if current trends in RGPCD and UAW are maintained (MassDEP 2021).

Halifax adjusts their outdoor watering restriction based on recommendations from Massachusetts Water Works Association (Halifax Water Department 2022a). They are required to implement either Calendar- or streamflow-triggered nonessential outdoor water use restrictions through their WMA permit.

10.3 Issues and Concerns

10.3.1 Water Supply Issues

10.3.1.1 Water Quality Issues

- In 2022, 1 out of 22 drinking water sites tested above the action level for lead (Halifax Water Department 2022b).
- In 2021, sodium concentrations in drinking water were up to 48.4 ppm, which is above the Massachusetts ORSG (Halifax Water Department 2022b).

Per- and Poly-Fluoroalkyl Substances

- Halifax did not list PFAS as a compound tested in their 2022 Annual Water Quality Report.
- Around 2021, Halifax started testing their wells for PFAS. The YMCA wells had very low levels of PFAS6 (non-detect to 2 ppt) so they have not tested as regularly. Richmond Well 1 has consistently measured between 5 and 15ppt for PFAS6 (Alpha Analytical 2023)

10.3.2 Other Issues

Halifax has identified contamination of groundwater and standing water from septic systems and as a cause of algal blooms as a concern in their MVP workshop (OCPC 2021). Also, they listed the following environmental vulnerabilities in their MVP:

- Phosphorus and other nutrients from bogs
- Flow from pond though brooks
- Inadequate circulation
- Diversions from Sliver Lake
- Beaver problems
- Old dams in disrepair or nonrepair

Monponsett Pond, located on the Hanson/Halifax town line has seen increasing counts of bacteria. Monponsett Pond is periodically diverted to Silver Lake, which is a drinking water supply source for the City of Brockton. This lake is eutrophic, perhaps hyper-eutrophic. The Monponsett Watershed Association was formed in 2012 in Halifax to address concerns with the lake condition. To date, most of their discussion has centered on the Brockton Water Department's use and control of East and West Monponsett Pond via a dam at the Stump Brook outlet and diversions of water to Silver Lake in Kingston. The Town of Halifax has treated the lake with alum in 2013 to 2015. (OCPC 2021).

10.4 Water Supply Alternatives

- The town identified providing additional storage as an action item in their MVP workshop (OCPC 2021).

10.5 Questions

No Answers Provided

- Is the interconnections section correct? Are these one-way interconnections, two-way connections, or emergency connections? What is the capacity and source location for these? Is the water treated or raw? Are there any blending issues?
- Are there plans in place for additional emergency water supplies?
- Is there information on the number of residents on private wells? Are approximate locations available?
- Does Halifax have projections for future demand?
- Can you provide the town's historical population data and water use from 2000 to present?
- Can you provide any future population estimates if the town uses a different source than University of Massachusetts Donahue Institute's projections?
- What are the main nonresidential uses? Is it mainly commercial/industrial or municipal/institutional? Are there any projected increases or decreases in nonresidential demand?
- Are projections available on the amount of units and timing associated the MBTA Community requirements? Are there estimates of water usage for these units?

10.6 References

Alpha Analytical. 2023. PFAS Labs.

Halifax Water Department. 2022a. Annual Statistics Report.

———. 2022b. Annual Water Quality Report.

Lindsey, Bill. 2024. Individual Interviews

Massachusetts Department of Environmental Protection (MassDEP). 2021. WMA Permit #9P-4-25-118.01.

Old Colony Planning Council (OCPC). 2021. Municipal Vulnerability Preparedness and Hazard Mitigation Plan.

11.0 Hanover

Hanover uses nine groundwater wells at four different sites to supply drinking water. These sites are located on Broadway, Hanover Street, Pond Street, and Riverside Drive (Hanover Planning Department 2018). The Broadway, Hanover Street, and Riverside Drive locations each have two wells. The Pond Street location has three wells. Hanover community members also use private wells (MAPC 2023).

Hanover's water withdrawal registration was renewed in 2023 and is set to expire in 2033 (MassDEP 2023). 7 wells are registered. In addition, Hanover has a WMA permit effective 2002-2010 and which is still in effect. Hanover has been operating under an Administrative Consent Order since 2018 because of exceedances of their WMA Permit. The two Philip Beal Wells are permitted (MassDEP 2002).

Table 1.1 includes Hanover's 2022 average daily withdrawal along with the total registered and permitted withdrawal for 2022.

Table 11.2 includes further details on Hanover groundwater supply sources.

Table 1.1 Average Daily and Registered + Permitted Withdrawals (Hanover Water Department 2022)

	2022 ASR	WMA Permit #9P3-4-21-122.01
Drinking Water Source	Average Daily Withdrawal (MGD)	Registered + Permitted[17] Withdrawal, 2023–2033 (MGD)
South Coastal Basin (wells)	1.27	1.27 + 0.11 = 1.38

Table 11.2 Water Supply Information for the Town of Hanover (Hanover Water Department 2022)

Source ID	Source Name	MassDEP Approved Max Day Volume	Maximum Single Day Pumped Volume (MGD)
4122000-09G	Philip C. Beal Well 1[18]	0.83	0.11
4122000-10G	Philip C. Beal Well 2		0.35
4122000-01G	Pond Street Well 1	0.275	0.21
4122000-05G	Pond Street Well 2	0.370	0.66
4122000-08G	Pond Street Well 3	0.550	0.65
4122000-03G	Hanover Street Well 1	0.244	0.27
4122000-04G	Hanover Street Well 2	OFFLINE	0
4122000-07G	Broadway Well 2	0.259	0.23
4122000-06G	Broadway Well 1	0.259	0.27

[17] Registered + Permitted: Registrations refer to established renewable water withdrawals established prior to 1988. Permitted withdrawals refer to WMA Permits issued for withdrawals beyond any registration amounts for ground or surface water sources in excess of an annual average of 100,000 gallons per day or 9 million gallons in any 3-month period.

[18] According to WMA Permit #9P3-4-21-122.01, the combined daily rate of Philip C. Beal Wells 1 and 2 shall not exceed 0.83 MGD (MassDEP, 2001).

11.1 Water Supply

11.1.1 Water Treatment

Hanover uses four water treatment facilities. **Table** lists these WTPs with their capacities.

Table 11.3 Hanover Treatment Plants (Hanover Water Department 2022)

Treatment Plants	Source	Treatment	Capacity (MGD)
Pond Street Treatment Plant	Pond Street Well 1, Pond Street Well 2, Pond Street Well 3	Softening (hardness removal), iron removal, particulate removal, corrosion control, disinfection	2
Broadway Street Greensand Plant	Hanover Street Well 2 (04G), Broadway Well 1 (06G), Broadway Well 2 (07G), Hanover Street Well 1 (03G)	Manganese removal, disinfection, iron removal, corrosion control	1.432
Philip C. Beal Treatment Plant	Philip C. Beal Well 1, Philip C. Beal Well 2	Iron removal, disinfection	Unknown

11.1.2 Water Storage

Table lists the three operating storage facilities with their capacities.

Table 11.4 Storage Tanks and Capacities (Hanover Water Department 2022)

Storage Facility	Capacity (MGD)	Storage Type
Union Street 1	0.63	Ground level
Union Street 2	2	Ground level
Walnut Hill	1	Ground level

11.1.3 Water Distribution System

Table 11.5 provides further details on the water distribution system.

Table 11.5 Distribution System Information for the Town of Hanover (Hanover Water Department 2022)

Distribution System Information (2022)	
Number of Service Connections	5,142
Number of Distribution Systems	1
Finished Water Storage Capacity (MG)	3.63
Pumping Capacity (gpm)	2,400
Total Miles of Water Mains	109
Estimated Volume (MG) Lost to Leaks	13.560

11.1.4 Interconnections

Neal Merritt describes that Hanover is hesitant to use their interconnections because Hanson uses a chloramine system and the interconnection communities do not. (Merritt 2024). The two interconnections are described in **Table 11.6.**

Table 11.6 Information on Alternative Source Water Options and Interconnected Utilities (Hanover Water Department n.d)

Interconnection	Location	Type
Norwell Water Dep	Abutting town at (42.15758, -70.85138) and (42.15519, -70.87297)	Emergency Treated Two-way
Abington Rockland Joint Water Works	Abutting town at (42.11983, -70.8895) and (42.13806, -70.89537)	Emergency Treated Two-way

11.1.5 Private Wells

CDM Smith has received a list of private wells from Hanover.

11.2 Water Demand

Table 11.7 outlines water demand information for the Town of Hanover.

Table 11.7 2022 Water Demand Information for the Town of Hanover (Hanover Water Department 2022)

2022 Demand Information	
MDD (raw)	1.92 MGD
ADD (raw)	1.27 MGD
UAW	9.4%
RGPCD	53 gallons/person/day

Hanover's water demands peak during the summer. These peak demands significantly stress Hanover's water supply capacity. Historically, Hanover has restricted outdoor water use because of this (MAPC 2023). In 2022, Hanover indicated they planned to institute nonessential outdoor water use restrictions (Hanover Water Department 2022). The population of Hanover is expected to plateau by 2030 (Hanover Planning Department 2018).

11.3 Issues and Concerns

11.3.1 Water Supply Issues

- Hanover is reliant on groundwater for drinking water supply. There is concern that as drought become more frequent and rainfall patterns change, recharge to Hanover's aquifers may decrease (MAPC 2023).
- As a result of climate change, Hanover anticipates trends towards increased drought are likely to worsen strain on Hanover's water supply during the summer (MAPC 2023).

11.3.1.1 Water Quality Issues

- As a result of the former National Fireworks site, an advisory has been placed on Factory Pond, Indian Head River, and Drinkwater River since the 1990s because of elevated concentrations of metals. Fish from these waterbodies should not be consumed, but it has been determined these elevated metals are not impacting Hanover's drinking water supply. Remediation of the National Fireworks site is currently in the option evaluation and selection phase (Hanover Planning Department 2018).
- Climate change may also impact water quality as recharge areas expand and wells may draw contaminants from new sources.
- Hanover is concerned with balancing development and protection of water supply.
  - One area of particular concern is Route 53. Hanover's Well Protection Zone and Aquifer Protection Zones neighbor portions of this route. Protecting the water supply must inform any development in these areas (Hanover Planning Department 2018).
  - Hanover has emphasized the importance of protecting the open land around the Indian Head River and the freshwater tidal marsh to protect the drinking water supply, and the town plans to partner with neighboring communities to prevent contamination (MAPC 2023).
  - Hanover plans to buffer contamination to the Water Resource Protection District (Hanover Planning Department 2018).

Per- and Poly-Fluoroalkyl Substances

- PFAS6 was detected at 19 ppt (Hanover Department of Public Works 2022).
- Hanover has indicated they anticipate providing treatment and education regarding PFAS in the future. Treatment may occur at the home or town level (MAPC 2023).
- Alternative drinking water sources may also avoid PFAS contamination (MAPC 2023).

11.3.2 Water Demand Issues

- Peak summer water demands significantly stress Hanover's water supply capacity. Climate change trends towards increased drought are likely to worsen peak summer water demand in the future (MAPC 2023).
- Climate change is also likely to increase wildfires within Hanover and will require an increased water supply for firefighting (MAPC 2023).

11.4 Water Supply Alternatives

- Hanover is considering using regional water supply to meet increasing demand and a potential partnership with MWRA (MAPC 2023).
- The Community of Hanover has expressed concern with Hanover's reliance on groundwater to supply drinking water. To improve resilience, Hanover has expressed interest in diversifying the water supply and installing additional private wells (MAPC 2023).

- The Beal WTP is within a sea level rise area. Hanover anticipates this plant may need to be relocated or reconstructed (MAPC 2023).
- To reduce drinking water demands, Hanover is considering incentivizing conservation (MAPC 2023).

11.5 Questions

Questions answered by Neal Merritt via email on 5/13/2024 are shown in blue.

- Is the town considering any other actions to reduce water demand? What are the historical restrictions that have been implemented and how well do these work? There are no plans to implement additional actions to reduce water demand. Historically, we have implemented calendar-based restrictions that are mailed to all postal patrons in the Town. I have attached our pending restriction for 2024 (a little later than we would like) which is typical of our prior restriction notices. Regarding the effectiveness of these restrictions in reducing demand, I would say they help reduce demand in the majority of Hanover's customers. However, there is a sizable population in Town that resist our efforts to curtail water usage in spite of our increasing block rate structure and the threat of fines.
- Is the interconnections section correct? Are these one-way interconnections, two-way connections, or emergency connections? What is the capacity and source location for these? Is the water treated or raw? Are there any blending issues? I recently updated our interconnection information in our Emergency Response Plan. All interconnections are two-way, treated water. Our system is a chloramine system so we are hesitant to use these interconnections as the two interconnected systems are not using chloramines. Therefore, I would classify all as emergency interconnections.
- Are there plans in place for additional emergency water supplies? No
- Can you provide any future population estimates if the town uses a different source than the University of Massachusetts Donahue Institute's projections? No
- Are projections available on the amount of units and timing associated the MBTA Community requirements? Are there estimates of water usage for these units? I am not aware of any projections.

11.6 References

Abington Rockland Joint Water Works (ARJWW). 2021. Emergency Response Plan.

Hanover Department of Public Works. 2022. Hanover Annual Water Quality Report.

Hanover Planning Department. 2018. Hanover Master Plan.

Hanover Water Department. 2022. Annual Statistics Report.

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Merritt Neal. 2024. Email Response to Questions

Massachusetts Department of Environmental Protection (MassDEP). 2023. Registration Renewal Statement

———. 2002. WMA Permit #9P-4-21-122.01.

Metropolitan Area Planning Council. 2023. Hanover MVP Report.

12.0 Hanson

Hanson draws water from four wells at the Crystal Springs Wellfield. Hanson previously purchased its water from Brockton, but currently only maintains one interconnection with Brockton as backup supply (Hanson Water Department 2022a).

In their 2022 ASR, Hanson recorded 97% of their water coming from groundwater and 3% being purchased (Hanson Water Department 2022b).

Hanson's current WMA Permit was renewed in 2021 and specifies a maximum authorized annual average withdrawal limit (**Table 12.1**) and maximum daily withdrawal rates for each well (**Table 12.2**). Hanson is also impacted by the mitigation condition of the WMA Permit. Hanson's baseline withdrawal from the Taunton River Basin is 0.72 MGD (average withdrawal from 2003 through 2005 plus 5%). Hanson is responsible for a mitigation volume of 0.06 MGD (baseline basin withdrawal subtracted from authorized basin withdrawal). However, since Hanson is handled by septic systems, it is assumed that 85% of the water withdrawn is returned to the basin via groundwater returns. Therefore, Hanson is only responsible for 15% of the 0.06 MGD mitigation volume, a total of 9,000 gallons per day. Hanson fulfills this requirement through their wetlands bylaws and regulations (MassDEP 2021).

Table 12.1 Hanson's Maximum Authorized Annual Average Withdrawal Compared with 2022 Usage

	2022 ASR	WMA Permit #9P425123.01
Drinking Water Source	Average Daily Withdrawal (MGD)	Registered + Permitted[19] Withdrawal, 2020–2030 (MGD)
Taunton River Basin	0.58	0.51 + 0.27 = 0.78

Table 12.2 Hanson's Maximum Daily Withdrawal Rate Compared with 2022 Usage

	2022 ASR	WMA Permit #9P425123.01
Drinking Water Source	Maximum Daily Rate (MGD)	Maximum Daily Rate (MGD)
Crystal Springs Well (Well 1)	0.315	0.5
Crystal Springs Wellfield (Wells 3, 4, 5)	Not Available*	Combined Maximum Daily Rate of 0.864

*max daily rates not reported as combined rate, only individually

[19] Registered + Permitted: Registrations refer to established renewable water withdrawals established prior to 1988. Permitted withdrawals refer to WMA Permits issued for withdrawals beyond any registration amounts for ground or surface water sources in excess of an annual average of 100,000 gallons per day or 9 million gallons in any 3-month period.

12.1 Water Supply

12.1.1 Water Treatment

Table 12.3 describes Hanson's WTP.

Table 12.3 Treatment Plants and Capacities (Hanson Water Department 2022b)

Name	Capacity (MGD)	Source	Treatment
Pumping Station off Franklin Street	1.076	Wells 1, 3, 4 5	Disinfection, corrosion control

12.1.2 Water Storage

Table 12.4 summarizes Hanson's storage capacity.

Table 12.4 Storage Tanks and Capacities (Hanson Water Department 2022b)

Name	Capacity (MG)	Storage Type
High Street Tank	1	Elevated Storage Tank

12.1.3 Water Distribution System

In 2022, 96% of Hanson's water was distributed to residential areas (Hanson Water Department 2022b). **Table 12.5** provides information about the Hanson's distribution system.

Table 12.5 Distribution System Information for the Town of Hanson (Hanson Water Department 2022b)

Distribution System Information	
Number of Service Connections	3,477
Number of Distribution Systems	1
Finished Water Storage Capacity (MG)	1
Pumping Capacity (gpm)	800
Total Miles of Water Mains	77
Estimated Volume (MG) Lost to Leaks	N/A

12.1.4 Interconnections

Hanson has seven interconnections with Brockton through which they sometimes buy water (Hanson Water Department 2022b). They also have three interconnections with ARJWW that have never been used (Environmental Partners 2018).

12.1.5 Private Wells

CDM Smith has not received data related to private well use within Hanson.

12.2 Water Demand

Table 12.6 provides water demand details from 2022.

Table 12.6 Water Demand Information for the Town of Hanson (Hanson Water Department 2022b)

Demand Information (2022)	
MDD (raw)	0.997 MGD
ADD (raw)	0.59 MGD
UAW	0.9 %
RGPCD	61 gallons/person/day

As shown on **Figure 12.1,** Hanson has gone from exceeding the 10% UAW standard to less than 1% UAW over the last 5 years (MassDEP 2021**).**

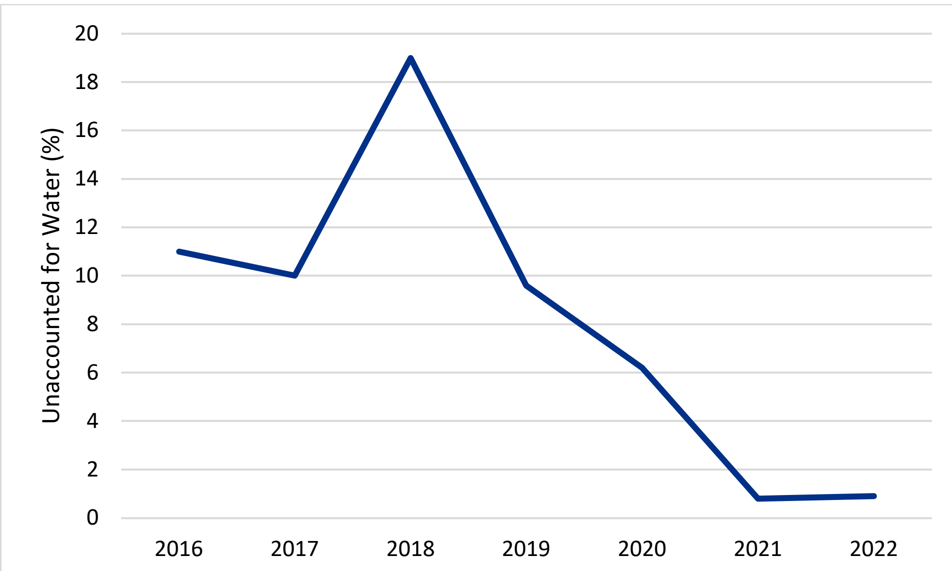

Figure 12.1 Hanson's Yearly Unaccounted for Water

- In accordance with their WMA Permit, Hanson institutes seasonal water restrictions. Only handheld hoses only from 7 to 9 a.m. and 5 to 7 p.m. are allowed. Sprinklers are not allowed unless connected to a private well (Town of Hanson 2023).
- Hanson based their demand projection off UMDI's population projection and average performance statistics based on 2012 to 2016. They estimated a 2035 ADD of 0.71 MGD and a MDD of 1.1 MGD (Environmental Partners 2018). UMDI's population projection proved to be on the higher side.
- DCR's projections were not provided for Hanson.

12.3 Issues and Concerns

12.3.1 Water Supply Issues

If the largest of Hanson's four wells went offline, the remaining three wells would be able to pump 0.82 MGD. This is adequate to meet the protected 2035 ADD of 0.71 MGD but not the estimated 2035 MDD of 1.10 MGD (Environmental Partners 2018).

12.3.1.1 Water Quality Issues

- In 2022, Hanson reported a sodium level of 35.6 ppm, which is above the Massachusetts ORSG standard of 20 ppm in their drinking water (Hanson Water Department 2022a).
- Hanson operates one chemical addition facility to treat all four wells. The town has reported that when all four wells are running simultaneously, the effluent is discolored, typically a light brown tea color. To prevent this from occurring, the town limits its withdrawals from the wells. During this period, the town must purchase water from Brockton to meet the system demands (Environmental Partners 2018).

Per- and Poly-Fluoroalkyl Substances

- Hanson did not find PFAS6 concentration greater than 10 ppt at any of their wells when sampled in 2021 (Town of Hanson 2021).

12.3.2 Other Issues

- Factory Pond, on the border of Hanson and Hanover, is polluted by extremely high levels of mercury and heavy metals (OCPC 2021). The former Nationals Fireworks waste site is considered the most likely source of mercury and is currently being remediated under the Massachusetts Contingency Plan. It seems funding might run out before the remediation is finished. There is discussion of making it a superfund site (North and South Rivers Watershed Association 2021, 2024).
- Harmful algal blooms have been reported in two of Hanover’s water bodies, Wampatuck Pond, and Indian Head Pond (MassDEP 2022).
- Water bodies identified as at risk for nutrient bacteria issues and algal blooms include Maquan Pond, Monponsett Pond, Oidham Pond, Wampatuck Pond, Indian Head Pond, Factory Pond, and Cranberry Cove (OCPC 2021).

12.4 Current and Future Alternatives

12.4.1 Water Supply Alternatives

- Hanson lists development of a second wellfield as a priority in their MVP workshop (OCPC 2021). This second source is nearing the permit completion stage. Source would be in the South Coastal River Basin, as opposed to the Taunton River Basin where the existing wells are located.
- Explore intermunicipal water tie in agreements with Halifax, Rockland, and Brockton (OCPC 2021).
- The MVP workshop identified construction of a new water storage tower to increase the storage capacity during drought events as a high priority (OCPC 2021).

12.4.2 Water Demand Alternatives

- Consider tie in with Whitman Wastewater Treatment Plant for the proposed 40B project in South Hanson, South Main Street (OCPC 2021).

12.5 Questions

No Answers Provided

- Are you seeing an increase in the amount of water you purchase from Brockton?
- How did unaccounted for water decrease so drastically?
- Is the interconnections section correct? Are these one-way interconnections, two-way connections, or emergency connections? What is the capacity and source location for these? Is the water treated or raw? Are there any blending issues?
- Are there plans in place for additional emergency water supplies?
- Is there information on the number of residents on private wells? Are locations available?
- Does Hanson have projections for future demand?
- Can you provide the town's historical population data and water use from 2000 to present?
- Can you provide any future population estimates if the town uses a different source than the University of Massachusetts Donahue Institute's projections?
- What are the main nonresidential uses? Is it mainly commercial/industrial or municipal/institutional? Are there any projected changes in nonresidential demand?
- Are projections available on the amount of units and timing associated the MBTA Community requirements? Are there estimates of water usage for these units?

12.6 References

Environmental Partners. 2018. Water System Master Plan.

Hanson Water Department. 2022a. Annual Drinking Water Quality Report.

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Old Colony Planning Council (OCPC). 2021. Integrated Municipal Vulnerability Preparedness and Hazard Mitigation Plan.

Town of Hanson. 2021. Annual Town Report.

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13.0 Kingston

Kingston has seven public water supply wells in the South Coastal Basin: Grassy Hole, Millgate Road, Soule's Pond, South Street, Trackle Pond, Well 1-86, and Winthrop Street (Kingston Planning Board 2017). The Trackle Pond Well and the I-86 well are permitted, and the rest are registered. The Winthrop Street well has been closed since 1987 because of petroleum products in the groundwater (Kingston Planning Board 2017).

Kingston's current WMA Permit was renewed in 2016 and specifies a maximum authorized annual average withdrawal limit (**Table 13.1**) and maximum daily withdrawal rates for each well (**Table 13.2**). According to the WMA, Kingston used to frequently exceed their approved daily pumping rates for the Grassy Hole Well and Well I-86. Therefore, the 2016 permit includes a condition that limits the daily combined pumping of the two wells to the approved daily rate of Grassy Hole Well (0.864 MGD) until Kingston develops and implements a monitoring plan approved by the MassDEP. Due to this restriction, Kingston does not pump these two wells concurrently. If they can prove that concurrent pumping will not adversely affect stream and/or pond levels, then MassDEP might approve concurrent pumping in the future (Mass DEP 2016).

DCR is currently preparing a new WNF for Kingston. While preparing the WNF, Kingston found significant leakage. Depending upon the extent of the leak and the projections of the WNF, they may be applying for a new permit (LeVangie 2024)

Table 13.1 Average Daily and Registered + Permitted Withdrawals (MassDEP 2016, Kingston Water Department 2023)

	2023 ASR	WMA Permit #9P-4-25-018.01	
Drinking Water Source	Average Daily Withdrawal (MGD)	Registered + Permitted[20] Withdrawal, 2020–2025 (MGD)	Registered + Permitted Withdrawal, 2025–2030 (MGD)
South Coastal Basin	1.63	0.99 + 0.34 = 1.33	0.99 + 0.48 = 1.47

Note: Red text = permit violation

[20] Registered + Permitted: Registrations refer to established renewable water withdrawals established prior to 1988. Permitted withdrawals refer to WMA Permits issued for withdrawals beyond any registration amounts for ground or surface water sources in excess of an annual average of 100,000 gallons per day or 9 million gallons in any 3-month period.

Table 13.2 Kingston's Maximum Daily Withdrawal Rate Compared with 2022 Usage (MassDEP 2016, Kingston Water Department 2023)

	2023 ASR	WMA Permit #9P-4-25-018.01
Drinking Water Source	Maximum Single Day Pumping Rate (MGD)	Authorized Maximum Daily Rate (MGD)
Grassy Hole on Smith's Lane near K.C. Mall	0.84	0.864
Millgate Road	0.661	0.540
Soule's Pond	0.38	0.270
South Street	0.712	0.809
Trackle Pond	0.92	1.44
Well 1-86	0	0.81
Winthrop Street	INACTIVE	0.576

Kingston's permit also required monitoring to assess the potential impact to a vernal pool adjacent to Trackle Pond well.

13.1 Water Supply

13.1.1 Water Treatment

Table 13.3 outlines the Town of Kingston's three water treatment facilities**.**

Table 13.3 Treatment Plants and Capacities (ResilientCE 2024, Kingston Water Department 2023)

Treatment Plants	Source	Treatment	Capacity (MGD)
South Street Station	Soules Ponds GP Well 1, South Street GP Well, Millgate Rd GP Well	Corrosion control	1.44
Grassy Hole and I-86 Treatment Facility	Well No I/86, Grassy Hole GP Well	Corrosion control, disinfection, iron removal	1.5
Trackle Pond Treatment Facility	Trackle Pond Well	Corrosion control, disinfection, manganese removal	3

13.1.2 Water Storage

The Town of Kingston operates four water storage facilities. **Table 13.4** outlines these facilities.

Table 13.4 Storage Tanks and Capacities for the Town of Kingston (ResilientCE 2024)

Storage Facility	Capacity (MG)	Storage Type
Smith's Lane Tank	0.5	Ground level
Indian Rd	0.36	Underground
Pembroke Street Tank	1	Elevated
Elm Street	2	Ground level

13.1.3 Water Distribution System

Ninety-five percent of Kingston's homes and buildings are connected to the water system (Kingston Planning Board 2017). Seventy-seven percent of water demand is residential, 19% is commercial, and less than 4% is municipal/institutional use. **Table 13.5** details Kingston's water distribution system (Kingston Water Department 2023).

Table 13.5 Distribution System Information for the Town of Kingston (Kingston Water Department 2023)

Distribution System Information	
Number of Service Connections	5095
Number of Distribution Systems	1
Finished Water Storage Capacity (MG)	3.5
Pumping Capacity (gpm)	3,450
Total Miles of Water Mains	110
Estimated Volume (MG) Lost to Leaks	8.42

13.1.4 Interconnections

Kingston has emergency interconnections (non-metered hard piped and/or hydrant-to-hydrant) with Duxbury, Plymouth and Pembroke. None of these emergency interconnections have been used in recent memory (past 20 years) (ResilientCE 2024).

13.1.5 Private Wells

Homes located along Route 80 are served by private wells (Kingston Planning Board 2017).

13.2 Water Demand

Table 13.6 outlines details regarding water demand in the Town of Kingston.

Table 13.6 Water Demand Information for the Town of Kingston (Kingston Water Department 2023)

Demand Information	
MDD (raw)	0.92 (MG)
ADD (raw)	1.63 (MG)
UAW	22%
RGPCD	65 gallons/person/day

Note: Red text = permit violation

Kingston's historical UAW and RGPCD are displayed in **figures 13.1** and **13.2** below (ResilientCE 2024).

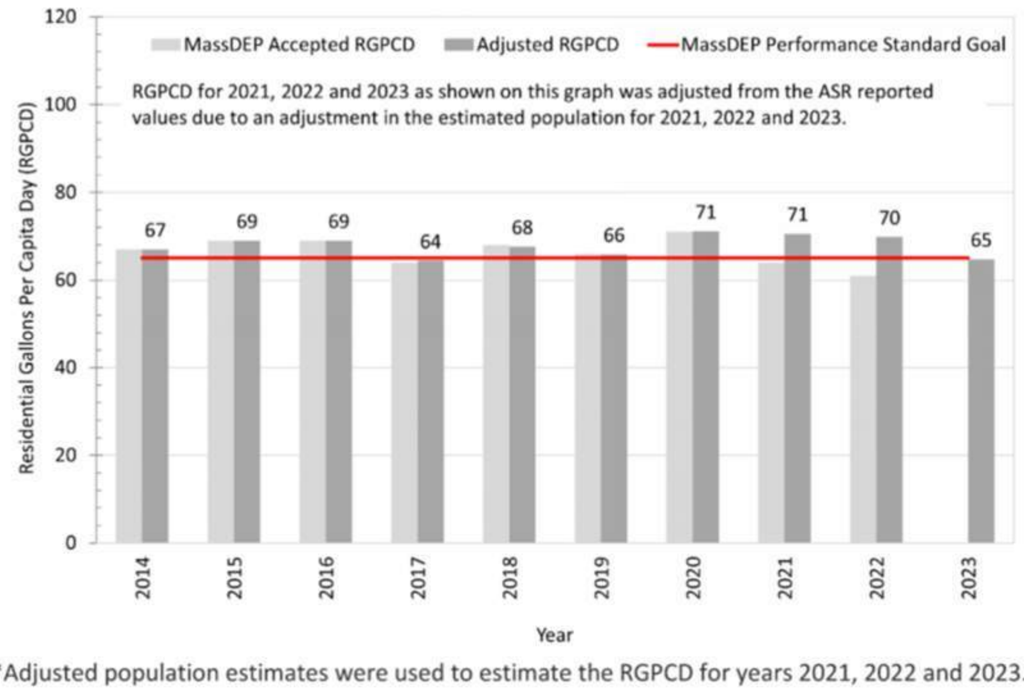

Figure 13.1 Kingston's Historical Residential Gallons Per Capita Day

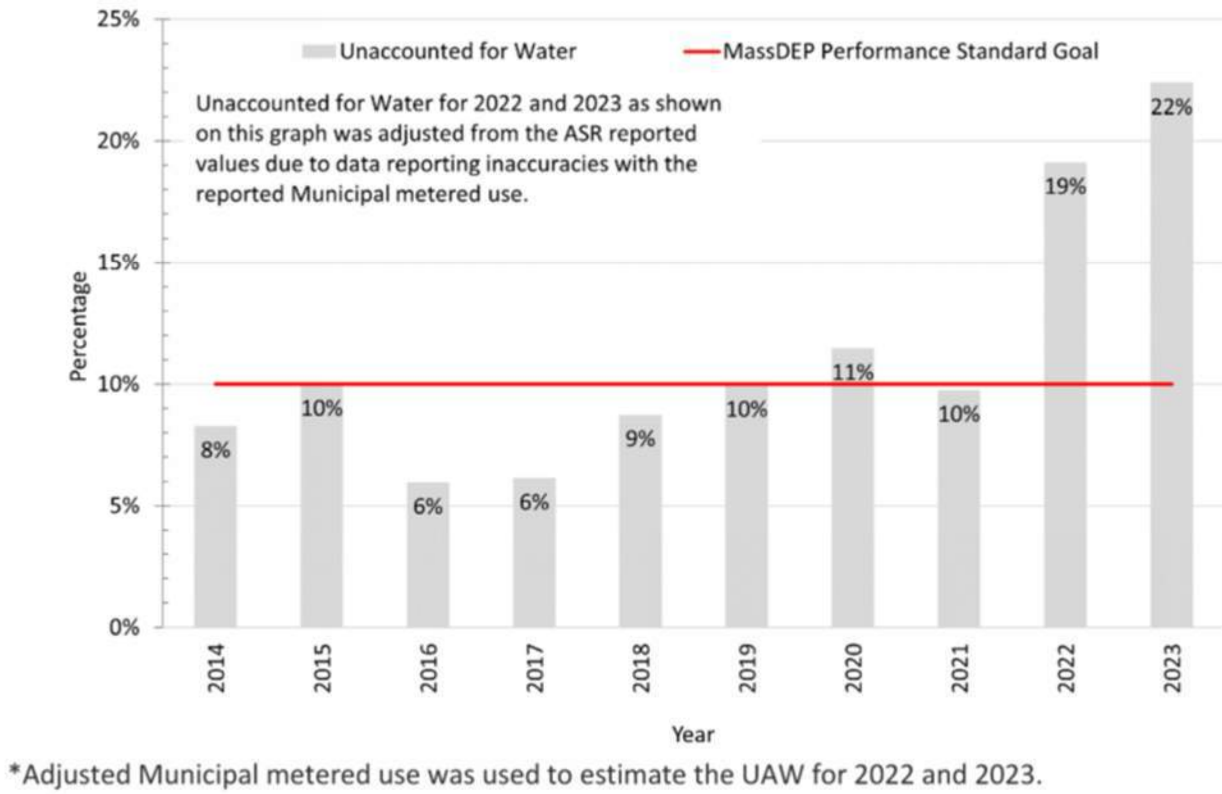

Figure 13.2 Kingston's Historical UAW

As per the their WMA permit, Kingston chooses to implement a calendar-triggered nonessential water use restriction between May 1st and September 30th, (Kingston Water Department 2023). Additionally, Kingston prohibits the connection of inground irrigation systems to be connected to the public water supply (ResilientCE 2024).

Kingston hired Comprehensive Environmental Inc to complete a water capacity analysis in 2017. In 2023, Resilient Civil Engineering, P.C (ResilientCE) was tasked with reviewing and updating the analysis. ResilientCE found that water use in Kingston was increasing quicker than anticipated by the 2017 analysis due to the water use changed from the Covid-19 pandemic and higher than expected population growth. They recommend that the town applied for a new WMA permit to expand their permitted capacity (ResilientCE 2023). A graph of historical and future demand compared with WMA authorized withdrawal is shown in **Figure 13.3.**

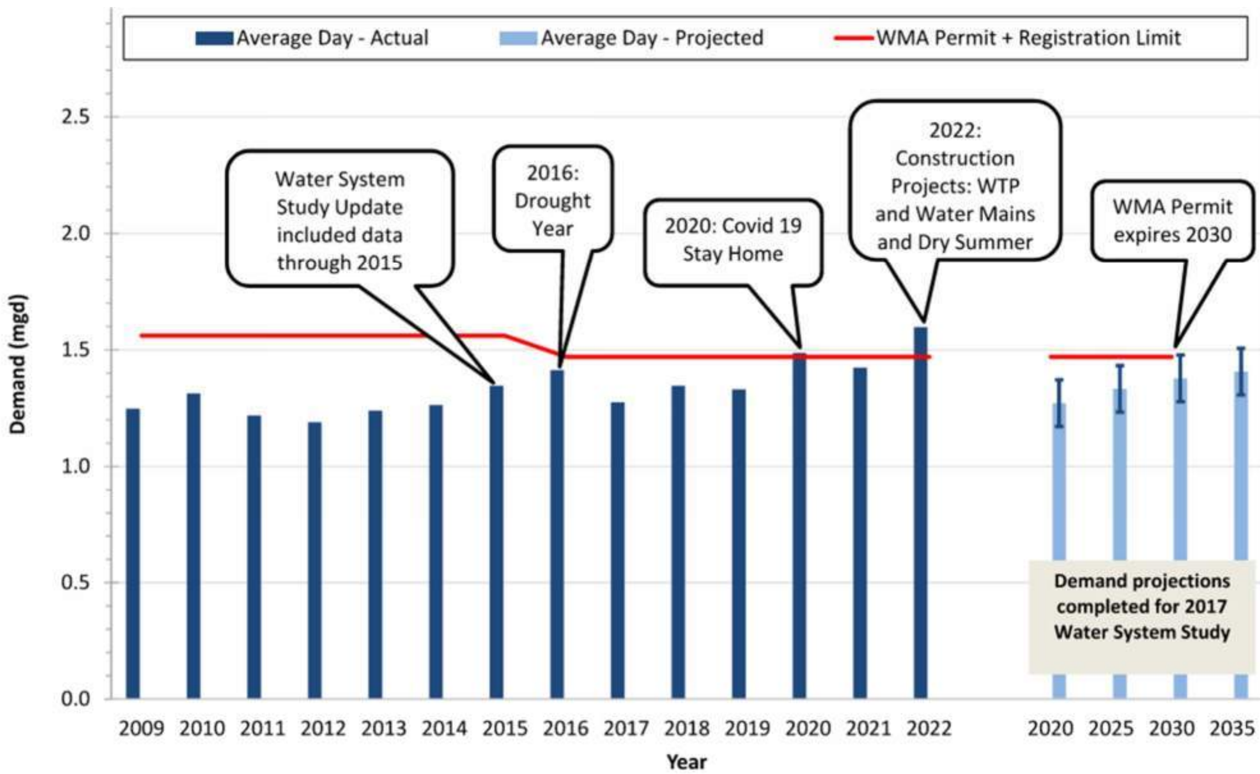

Figure 13.3 Average Day Water Demand in Comparison with WMA Permit Authorized Withdrawal (ResilientCE 2023).

ResilientCE also assessed the ability of Kingston's existing water supplies to meet water demands. The MassDEP Guidelines for Public Water Supplier requires that with any supply pump out of service, the remaining pumps shall be capable of providing the maximum daily pumping demand of the system. If Kingston's larges source, Trackle Pond well, went offline, then they would not be able to need maximum demand, even with all remaining wells pumping 24-hours a day (ResilientCE 2023). **Figure 13.4** shows the results of this analysis.

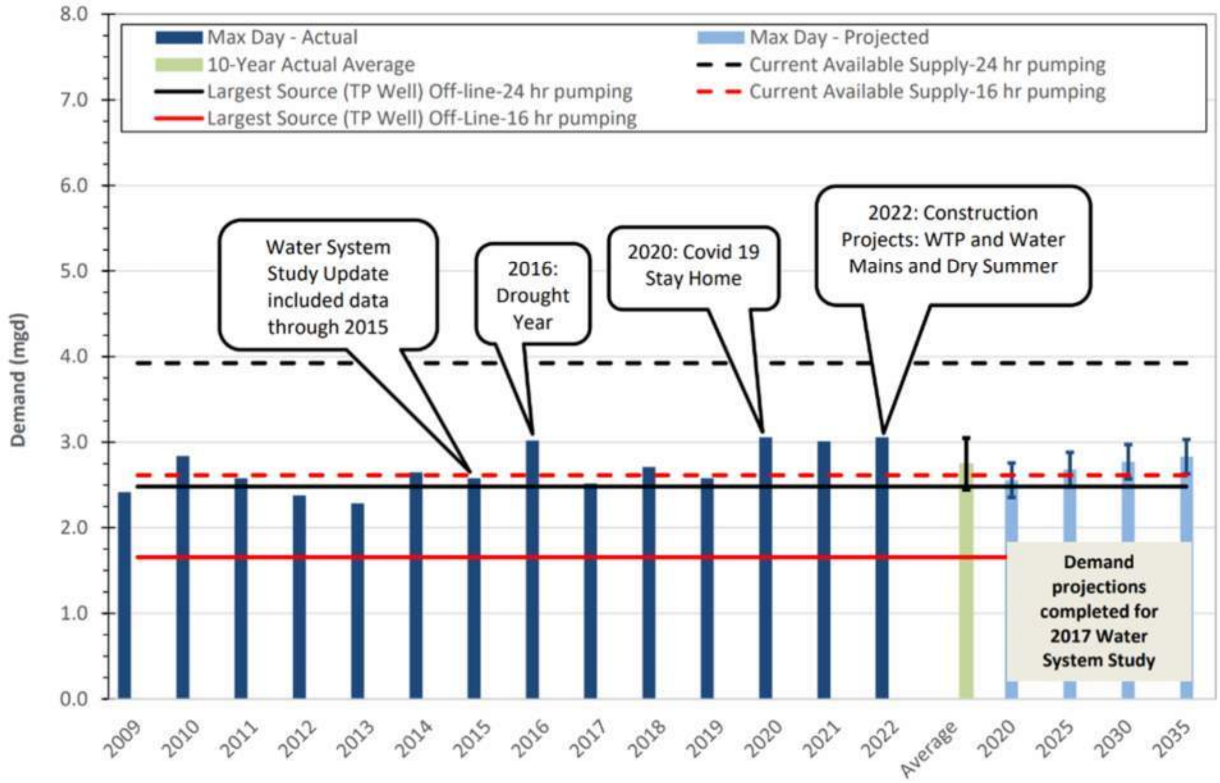

Figure 13.4 Maximum Day Demand Analysis- Assumes Alternate Pumping of Grassy Hole and I-86 Wells.

13.3 Issues and Concerns

13.3.1 Water Supply Issues

- Kingston exceeded permitted well limits as recent as 2023 and must continue to manage each well to its permitted limit (Kingston Water Department 2023).
- In 2017 a water supply system study projected Kingston's demands would increase by 14% from 2015 to 2035. However, Kingston has seen from 2015 to 2021 residential water use increased by 14%. In six years, Kingston saw an increase in water demand expected to take 20 years. This increased water demands have exceeded WMA permit authorized withdrawal (ResilientCE).
- Kingston has expressed that the town requires an additional source of water supply. A new well would ensure water supply resiliency and sustainability (Resilient Civil Engineering, 2023).

13.3.1.1 Water Quality Issues

- The Winthrop Street well has been closed since 1987 because of petroleum products in the groundwater (Kingston Planning Board 2017).
- In recent years, high acid levels have been observed in Kingston drinking water. Elevated levels of manganese are present in water withdrawn from the Trackle Pond well. As of 2014, this water is treated for manganese (Kingston Planning Board 2017).

- Rapid population growth along the coasts of Massachusetts have caused an increase in nutrient loading to surface and groundwater. Since 2008, nitrate levels have been increasing in all drinking water supply wells. The Winthrop Street well has the highest concentration of nitrate at 2.92 mg/L. This is below the MCL set by MassDEP, 5 mg/L; however, because of the increasing trend, Kingston would like to evaluate nitrogen contributions of new developments (CDM Smith 2022).
- In 2022, the drinking water quality was tested and 1 out of 30 sites sampled exceed the action level for lead and copper (Kingston Water Department 2022).
- Historically, Kingston has not pumped the Grassy Hole Well and the 1-86 Well concurrently to mitigate the impacts of manganese in these wells. Should the Town want to pump these wells concurrently, the WMA permits required development of an environmental monitoring plan and conducting the plan for a least one year prior to concurrent pumping to establish baseline conditions. (ResilientCE 2023)

PFAS

- PFAS sampling results were provided for 2022 and showed no detection for all sampled PFAS contaminants (Kingston Water Department 2022).

13.3.2 Water Demand Issues

- A developer has proposed constructing an apartment complex like the apartments at the Kingston Collection. In order for Plymouth to supply the apartment complex, they have required the developer fund the construction of a 550 gpm booster pump station to transfer water from the Town Center Pressure Zone to the West Plymouth Pressure Zone to address the supply deficit (ResilientCE 2024).

13.3.3 Other Issues

- Kingston would like to reduce septic system inputs to the groundwater to reduce contaminants to the groundwater drinking water supplies. Septic systems can leach contaminants such as bacterial and viral constituents, nitrogen, phosphorus, and other contaminants of emerging concern (CDM Smith 2022).
- Kingston has emphasized that it is extremely important to protect the natural landscape of undeveloped land in areas that provide groundwater recharge and filtration. Two areas of particular interest to Kingston are south/southwest of Crossman Pond and forested land south of Route 44 (Kingston Planning Board 2017).

13.4 Water Supply Alternatives

- Kingston has identified as site for a new well southwest of Trackle pond. The Town is in the processes of purchasing the land for the well (ResilientCE 2024).
- The town is thinking about installing a 0.5MG elevated storage tank on Country Club Way (ResilientCE).

13.5 Questions

Answers provided by Stacy Smith via email on 6/13/2024 are shown in blue.

- Are there plans in place for additional emergency water supplies? Yes, the Kingston Water Department has emergency interconnections with Duxbury, Pembroke and Plymouth that could be used for short-term emergencies such as a water main break.
- Can you share the 2017 Water System Study completed by Comprehensive Environmental? WE are interested in how you estimate future demand. This report is being superseded by the current project being completed this month and includes water demand projections by DCR.
- Are projections available on the amount of units and timing associated the MBTA Community requirements? Are there estimates of water usage for these units? The Water Department has not received this information and the DCR did not include this in the draft water needs forecast since no conceptual plan was made available.

13.6 References

CDM Smith. 2022. Kingston CWMP.

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LeVangie, Duane. 2024.

Plymouth Planning Board. 2006. Plymouth Massachusetts Master Plan. Water Supply Capacity Analysis

Resilient Civil Engineering (ResilientCE). 2024. Source Capacity Evaluation and Water Rate Study

———. 2023. Water Supply Capacity Analysis

14.0 Pembroke

Pembroke relies on four active groundwater supply wells. In additions, there are four inactive wells, one wellfield permitted but not yet built, and one wellfield being tested. Three of the wells are registered (Hobomock Well 1, Center St. Well 2, and Well 3) and 5 wells are permitted (Hobomock Well 1, Center St. Well 2, Bryantville Well 4, Windswept well #5, and Swanberg wellfield).

Pembroke's most recent WMA Permit was amended in September 2023 and specifies a maximum authorized annual average withdrawal limit (**Table 14.1**) and maximum daily withdrawal rates for each permitted well (**Table 14.2**). The permit amendment authorized a new well (Swanberg Wellfield). Pembroke also must comply with the mitigation condition of the WMA Permit. Pembroke's baseline withdrawal from the Taunton River Basin is 1.26 MGD (average withdrawal from 2003 through 2005 plus 5%). Pembroke is responsible for a mitigation volume of 0.58 MGD (baseline basin withdrawal subtracted from authorized basin withdrawal). Since Pembroke reports that 5% of its wastewater is discharged to the Taunton Basin through private septic systems and the remaining 95% is disposed of through on-site sewage disposal systems to the South Coastal Basin, MassDEP has adjusted the required mitigation volume to 0.099 MGD. Pembroke's acquisition of several closed cranberry bogs for conservation grants Pembroke enough credits to fulfill this requirement (MassDEP 2018 2023).

Table 14.1 Pembroke's Maximum Authorized Annual Average Withdrawal Compared with 2022 Usage

	2022 ASR	WMA Permit #9P-4-21-231.01	
Drinking Water Source	Average Daily Withdrawal (MGD)	Registered + Permitted[21] Withdrawal, 2023–2026 (MGD)	Registered + Permitted Withdrawal, 2026–2031 (MGD)
South Coastal Basin	1.16	0.99 + 0.71 = 1.70[22]	0.99 + 0.85 = 1.84

Table 14.2 Pembroke's Maximum Daily Withdrawal Rate Compared with 2022 Usage

	2022 ASR	WMA Permit #9P-4-21-231.01
	Maximum Daily Withdrawal (MGD)	Maximum Daily Rate (MGD)
Hobomock Well 1	Offline	0.53
Center Street Well 2	0.62	1
Well 3	0.35	0.504
Bryantville Well 4	0.24	1

[21] Registered + Permitted: Registrations refer to established renewable water withdrawals established prior to 1988. Permitted withdrawals refer to WMA Permits issued for withdrawals beyond any registration amounts for ground or surface water sources in excess of an annual average of 100,000 gallons per day or 9 million gallons in any 3-month period.

[22] With advances written approval from MassDEP, Pembroke is authorized to increase annual average daily withdrawals to the maximum authorized 1.85 MGD prior to 2026 if they meet these special permit conditions: 1) RGPCD of 65 or less, 2) UAW of 10% or less, 3) Seasonal Limits on nonessential outdoor water use, 4) Water conservation requirements.

	2022 ASR	WMA Permit #9P-4-21-231.01
Swanberg Wellfield	Anticipate online in 2026	0.37
Windswept Well 5	0.757 (max day) 0.43 (annual average)	Approved for 0.5 annual average daily rate per MassDEP letter of 7/26/2000, but pumping must cease when water level of Great Sandy Bottom Pond falls below 52.1 ft.

Pembroke's existing wells are in Subbasin 22023, which supports a coldwater fishery in Herring Brook. The Department of Fish and Game determined that only Well 1 was close enough to impact streamflow at Herring Brook. However, Well 1 has been offline since 2009 because of water quality concerns. If Well 1 goes online, then it will be constrained by Special Condition 9 of the WMA Permit, Coldwater Fish Resource Protection (MassDEP 2018). The Swanberg Wellfield is in subbasin 22022.

14.1 Water Supply

14.1.1 Water Treatment

Table 14.3 describes Pembroke's three WTPs.

Table 14.3 Treatment Plants and Capacities (Town of Pembroke 2022a)

Name	Capacity (MGD)	Source	Treatment
Station 2	1	Well 2	Disinfection, corrosion control, fluoridation
Station 3	0.504	Well 3	Disinfection, corrosion control, fluoridation
Station 4	1	Wells 4 and 5	Disinfection, corrosion control, fluoridation, iron removal

14.1.2 Water Storage

Table 14.4 summarizes Pembroke's storage capacity. The High Street Tank has been empty and isolated from the water distribution system via a closed values in High Street since the boil order in summer 2018 (Town of Pembroke 2021).

Table 14.4 Storage Tanks and Capacities (Town of Pembroke 2022a)

Name	Capacity (MG)	Storage Type
Oak Street Tank	0.3	Elevated Storage Tank
Learning Lane Tank	0.5	Elevated Storage Tank
High Street Tank	0.25 (inactive)	Elevated Storage Tank
West Elm Street Tank	0.75	Elevated Storage Tank
Total	1.55	—

14.1.3 Water Distribution System

In 2022, 89% of Pembroke's water was distributed to residential areas (Town of Pembroke 2022a). **Table 14.5** provides information about the Pembroke's distribution system .

Table 14.5 Distribution System Information for the Town of Pembroke (Town of Pembroke 2022a)

Distribution System Information	
Number of Service Connections	6,373
Number of Distribution Systems	4
Finished Water Storage Capacity (MG)	1.55
Pumping Capacity (gpm)	2,986
Total Miles of Water Mains	132
Estimated Volume (MG) Lost to Leaks	0

14.1.4 Interconnections

According to Pembroke's Annual Water Quality Report, Pembroke has emergency interconnections with Duxbury, Hanson, Hanover, and Kingston (Town of Pembroke 2022b). A few more interconnections were described in Pembroke's Emergency Response Plan (Town of Pembroke 2021) (**Table 14.6**). These were confirmed in correspondence with Pembroke in 2024. Each emergency interconnection is a line gate between the two distribution systems, unmetered or regulated for emergencies only and the flows would be determined by system hydraulics. Pembroke is in the process of reestablishing their metered interconnection with Brockton, which would be a preferred source of water for the town if needed (Sullivan 2024).

Table 14.6 Description of Pembroke's Water Supply Interconnections (Town of Pembroke 2022a)

Interconnection	Street Location	Type	Water Main Size (inches)
ARJWW	Phillips Road	Emergency	6
City of Brockton	Mattakeesket Street at School Street	Potential Source	6
Town of Duxbury	High Street	Emergency	8
Town of Duxbury	Birch Street	Emergency	8
Town of Hanover	Washington Street	Emergency	8
Town of Hanson	Oldham Street at Town Line	Emergency	8
Town of Kingston	School Street	Emergency	8 x 10

14.1.5 Private Wells

The town estimates that 250 residences are served by private wells (Woodard and Curran 2022).

14.2 Water Demand

In 2018, with assistance from the Old Colony Planning Council, the town completed a Housing Production Plan that assumes a population increase of 963 by 2030. The plan acknowledges that while Pembroke has 521 acres of developable residential land, it is constrained by the town's significant acreage of wetlands and floodplain, permanently protected open space, and lack of public sewerage (Woodard and Curran 2022). **Table 14.7** provides water demand details from 2022.

Table 14.7 Water Demand Information for the Town of Pembroke (Town of Pembroke 2022a)

Demand Information (2022)	
MDD (raw)	1.76 MGD

Demand Information (2022)	
ADD (raw)	1.16 MGD
UAW	9.8%
RGPCD	50 gallons/person/day

In accordance with their WMA Permit, Pembroke institutes seasonal restrictions on nonessential outdoor water use. They have a stricter level of restriction based on USGS Stream Gage 01105730 water levels (Pembroke Water Division, n.d).

14.3 Issues and Concerns

14.3.1 Water Supply Issues

According to their WMA Permit, Pembroke must cease drawing from Well 5 when the water levels in Great Sandy Bottom Pond drop below 52.1 feet above mean sea level. From 2011 to 2021, Pembroke Water Division had to take Well 5 offline on four separate occasions for approximately 4 to 6 weeks because of low pond levels (Environmental Partners 2021).

14.3.1.1 Water Quality Issues

- In 2022, Pembroke recorded 51 ppm of sodium and 217 ppb of manganese in drinking water (Town of Pembroke 2022b). The Massachusetts ORSG standard is 20 ppm for sodium and EPA's SMCL for manganese is 50 ppb.
- Pembroke reports that Well 2 has high concentrations of iron (~0.25 ppm) and manganese (~0.1-0.2 ppm). They have requested funding to design an iron and manganese treatment facility at well 2 that will also accommodate well 3 (Sullivan 2024).

Per- and Poly-Fluoroalkyl Substances

- In 2022, Pembroke recorded 3.3 ppt of Perfluorohexanoic acid (PFHxA) in their drinking water. This was the only one of 12 PFAS contaminants that was detected (Town of Pembroke 2022b).
- A lab report from July 6, 2023, records a raw water PFAS6 concentration of 2.7 ppt in Well 2, 2.1 ppt in Well 3, 7.5 ppt in Well 4, and 5.7 ppt in Well 5 (Analytical Balance 2023).

14.3.2 Water Demand Issues

- The 2016 Master Plan notes that "Pembroke Water Division's current sources do not have sufficient capacity to meet the maximum-day demands with the active wells; the 6-year average maximum-day demand from 2010 through 2015 was 2.30 MGD and the firm capacity is 1.5 MGD" (Environmental Partners 2021). The report recommends developing a new source outside of subbasin 22023 (part of the Jones River subbasin) to meet these demands and provide greater operational flexibility and redundancy (Environmental Partners 2021).

14.3.3 Other Issues

- Water treatment chemicals are stored within Well 1's inactive treatment station, which is within a Federal Emergency Management Agency (FEMA) flood zone (Environmental Partners 2021).
- Well 5 is dependent on pond levels of Great Sandy Bottom Pond; therefore, it is not a reliable source during drought (Environmental Partners 2021).
- The town is concerned that 40B development, specifically cluster housing near water resources, may have negative impacts on ecosystem systems and water quality (Woodard and Curran 2022).

14.4 Water Supply Alternatives

- The town is in the design phase of a new pump station on the Swanberg property which has a new well permitted for 350,000 GPD, expected to be online in 2026 (Sullivan 2024).
- Pembroke is in the process of installing a new well field on Elmer Street which will require a treatment plant but will likely supply 750,000 GPD, expected online in 2028 (Sullivan 2024).
- Pembroke is exploring the replacement of well 4 due to its recent reduced capacity (Sullivan 2024).
- In 2005, the town established the Water Resource and Groundwater Protection District to protect water quality near aquifer-fed wellheads (VHB 2024).
- According to Pembroke's Municipal Vulnerability Assessment and Hazard Mitigation Plan (Woodard and Curran 2022), the Water Division recently acquired land around Pudding Brook to install a sixth well. MassDEP is currently reviewing the well. In general, the town has been proactive in purchasing properties important for aquifer protection and as possible future sites for drinking water wells.
- The town seeks to construct a new storage tank at Oak Street (Woodard and Curran 2022).

14.5 Questions

Questions answered by Dan Sullivan via email on 5/9/2024 are shown in blue.

- Has the town built a new well? We are in the design phase of a new pump station on the Swanberg property in town which has a new well permitted for 350000 gallons a day. on line 2026? Also we are in the process of installing a new well field off Elmer St which will require a treatment plant but will likely supply 750,000 gpd(online 2028?) we are requesting funding this fiscal year to explore a replacement well 4 do to the reduced specific capacity it has experienced
- Is the interconnections section correct? Are these one-way interconnections, two-way connections, or emergency connections? What is the capacity and source location for these? Is the water treated or raw? Are there any blending issues? All of our interconnections are emergency except Brockton's. Each interconnection is simply a line gate between the two systems, unmetered or regulated for emergencies only and the flows would be determined by

system hydraulics. Brockton's metered interconnection is being reestablished this summer and would be the preferred source of water for the town if needed.

- Are there plans in place for additional emergency water supplies? No
- What are the main nonresidential uses? Is it mainly commercial/industrial or municipal/institutional? Are there any projected increases or decreases in nonresidential demand? Town just completed a master plan that would like to attract more commercial.

14.6 References

Analytical Balance. 2023. Certificate of Analysis.

Environmental Partners. 2021. Risk and Resilience Assessment.

Massachusetts Department of Environmental Protection (MassDEP). 2023. WMA Permit #9P-4-21-231.01.

———. 2018. WMA Permit #9P-4-21-231.01.

Pembroke Water Division. N.d. DPW Water Mandatory Restrictions May 1 through September 30-When Required. https://www.pembroke-ma.gov/water-division/pages/dpw-water-mandatory-restrictions-may-1-through-september-30-when-required.

Sullivan, Dan. 2024. Email Response to Annotated Bibliography Questions.

Town of Pembroke. 2022a. Annual Statistics Report.

———. 2022b. Annual Drinking Water Quality Report.

———. 2021. Water System Emergency Response Plan.

VHB. 2024. Pembroke Master Plan.

Woodard and Curran. 2022. Municipal Vulnerability and Hazard Mitigation Plan.

15.0 Plymouth

The Plymouth Water Division manages the Town of Plymouth's municipal water. The division supplies approximately 69% of the Town of Plymouth's population with drinking water from 13 gravel-packed wells in two watersheds (Environmental Partners 2019).

Plymouth is authorized to withdraw water under two WMA permits. The permit for the South Coastal Basin (WMA Permit #9P-4-21-239.01) was renewed in 2018 and specifies a maximum authorized annual average withdrawal limit for the South Coastal Basin (**Table 15.1**) and maximum daily withdrawal rates for the 10 wells within the South Coastal Basin (**Table 15.2**). The permit for the Buzzards Bay Basin (WMA Permit #9P-4-24-239.01) was renewed on October 9, 2023, and specifies maximum authorized annual average withdrawal limits for Buzzards Bay and combined basin withdrawals (**Table 15.1**) as well as maximum daily withdrawal rates for the 2 wells within the Buzzards Bay Basin (**Table 15.2**). Darby Pond and Federal Furnace wells are in the Buzzards Bay Basin, all other wells are in the South Coastal Basin.

WMA Permit #9P-4-24-239.01 also specifies the following conditions:

- Plymouth may only withdraw above an annual average daily withdrawal of 4.61 MDG if they comply with the requirements of a MassDEP approved RGPCD Functional Equivalence Plan
- Withdrawals may increase to an average daily withdrawal of up to 5.04 MGD prior to January 1, 2026 provided that Plymouth meets the UAW standard of 10% or less, and implements the requirements outlined in Special conditions 9 (seasonal limits on nonessential outdoor water use) and 10 (water conservation).

Table 15.1 Average Daily and Permitted Withdrawals (Plymouth Water Division 2022; MassDEP 2023, 2018)

	2022 ASR	WMA Permit #9P-4-21-239.01		WMA Permit #9P-4-24-239.01
Drinking Water Source	Average Daily Withdrawal (MGD)	Permitted[23] Withdrawal 2021-2025 (MGD)	Permitted Withdrawal, 2026-2030 (MGD)	Permitted Withdrawal, 2023–2032 (MGD)
Buzzard Bay	0.81	--	--	1.59
South Coastal Basin	3.33	4.71	5.04	--
Combined	4.14	--	--	5.04

[23] Permitted withdrawals refer to WMA Permits issued for withdrawals beyond any registration amounts for ground or surface water sources in excess of an annual average of 100,000 gallons per day or 9 million gallons in any 3-month period.

Table 15.2 Plymouth's Maximum Daily Withdrawal Rate Compared with 2022 Usage (Plymouth Water Division 2022; MassDEP 2023, 2018)

	2022 ASR	Water Management Permit #9P-4-21-239.01 or #9P-4-24-239.01
Drinking Water Source	Maximum Single Day Pumping Rate (MGD)	Authorized Maximum Daily Rate (MGD)
Ship Pond Well	0.49	0.86
No. Plymouth Well	0.92	1.53
Bradford GP Well	0.56	1.51
Ellisville GP Well	0.74	1.12
South Pond Well 1	0.73	1.12
South Pond Well 2	1.07	1.50
Savery Pond Well	1.04	1.50
Bradford Replacement Well 1A	0.55	1.51
Lout Pond Replacement Well	0.15	0.72
Wannos Pond Replacement Well	0.54	0.94
Federal Furnace Well	0.45	0.79
Darby Pond Well	0.96	0.80
Forges Field Well (2020)	0.87	1.05

Per their Buzzards Bay WMA permit (WMA Permit #9P-4-24-239.01), Plymouth must implement the Darby Pond Management Plan, which included pond level monitoring. If the pond falls below the level of 121.t ft above MSL, Plymouth must cease withdrawals from Darby Pond well, with a few exceptions outlined in the permit.

Plymouth also maintains backup water supplies at Great South Pond and Little South Pond (Plymouth Planning Board 2006). Additionally, Plymouth has an inactive emergency source of Lout Pond (Environmental Partners 2019).

In addition to the Plymouth Water Division, there are 11 additional public water systems located in the Town of Plymouth, including but not limited to Herring Cove Condominiums, Massachusetts Correctional Institution Plymouth, New Testament Church, Plymouth South Elementary School, Plymouth South High School, Aquarion Water Company-Plymouth, The Baird Center, and the Pinehills Water Company (Plymouth Planning Board 2006).

15.1 Water Supply

15.1.1 Water Treatment

The Plymouth Water Division currently has 11 raw water treatment facilities to treat groundwater (Environmental Partners 2019). The contaminants of concern in Plymouth are dissolved and particulate iron and manganese. Three of Plymouth's water treatment facilities add phosphates to remove iron and manganese (Environmental Partners 2019). All treatment facilities adjust pH using sodium hydroxide, and use sodium hypochlorite for chlorine residual and disinfection. **Table 15.3** outlines the processes at each treatment facilities (Environmental Partners 2019).

Table 15.3 Plymouth Water Division Treatment Facilities (Environmental Partners 2019, Plymouth Water Division 2022)

Treatment Facilities	Sources	Treatment
Federal Furnace Well Pump Station	Federal Furnace Well	Disinfection, pH adjustment, Iron and Manganese sequestration
North Plymouth WTP	North Plymouth Well	Disinfection, pH adjustment, GAC filtration
Darby Pond Well Pump Station	Darby Pond Well	Disinfection, pH adjustment
South Pond Well Pump Station	South Pond Well 1, South Pond Well 2	Disinfection, pH adjustment
Lout Pond Well Pump Station	Lout Pond Well	Disinfection, pH adjustment, Fe/MN sequestration
Bradford WTP	Bradford Well 1, Bradford Well 2	Disinfection, pH adjustment, particulate removal
Forges Field Well Pump Station	Forges Field Well	Disinfection, pH adjustment, Fe/Mn sequestration (future)
Ellisville Well Pump Station	Ellisville Well	Disinfection, pH adjustment
Ship Pond Well Pump Station	Ship Pond Well	Disinfection, pH adjustment
Wannos Pond Well Pump Station	Wannos Pond Well	Disinfection, pH adjustment, Fe/Mn sequestration
Savery Pond Well Pump Station	Savery Pond Well	Disinfection, pH adjustment

15.1.2 Water Storage

The Plymouth Water Division manages 10 storage facilities, as listed in **Table 15.4**.

Table 15.4 Plymouth Water Division Storage Facilities (Plymouth Water Division 2022)

Name	Capacity (MG)	Storage Type
North Plymouth Tank	1.15	Ground Level
Lout Pond Tank	1	Ground Level
North Pine Hill Tank	1	Ground Level
South Pine Hill Tank	1	Ground Level
Indian Hill Tank	1	Ground Level
Samoset Tank	.5	Ground Level
Chiltonville Tank	1	Ground Level
Stafford Tank	1.5	Ground Level
Harrington Tank	1.25	Ground Level
Cedarville Tank	1.6	Ground Level
Total	11.05	—

15.1.3 Water Distribution System

Plymouth water demands are broken down as follows: 75% Residential, 3% Residential Institution, 10% Commercial, 4% Industrial, and 8% Municipal (Martin 2024).

Table 15.5 provides details on the Plymouth Water Division distribution system. Approximately 25% of water distribution piping within Plymouth is made of asbestos cement piping. Plymouth has been working to replace these pipes (Environmental Partners 2019).

Table 15.5 Plymouth Water Division Distribution System Information (Plymouth Water Division 2022)

2022 Distribution System Information	
Number of Service Connections	14,850
Number of Distribution Systems	6
Finished Water Storage Capacity (MG)	11.05
Pumping Capacity (gpm)	9,605
Total Miles of Water Mains	265
Estimated Volume (MG) Lost to Leaks	54.66

15.1.4 Interconnections

The Town of Kingston has two emergency interconnections; however, in the event of an emergency, Plymouth anticipates Kingston may not have sufficient capacity to supply water to Plymouth (Environmental Partners 2019). **Table 15.6** outlines the interconnections (Environmental Partners 2019).

Table 15.6 Plymouth Interconnections (Environmental Partners 2019)

Interconnection	Size	Location
Kingston Water Division	8 inches	Independence Mall Way/Enterprise Drive
Kingston Water Division	12 inches	Route 3A

15.1.5 Private Wells

CDM Smith has not received data related to private well use within Plymouth.

15.2 Water Demand

Table 15.7 outlines demand information for the Plymouth Water District.

Table 15.7 Water Demand Information for the Town of Plymouth (Plymouth Water Division 2022)

Demand Information	
MDD (raw)	7.87 MG
ADD (raw)	0.427 MG
UAW	11%
RGPCD	60 gallons/person/day

Note: Red text = permit violation

As per their WMA permit, Plymouth implements restrictions for nonessential outdoor watering. During drought conditions in 2016, Plymouth declared a ban on nonessential outdoor use which effectively lowered demands for the remainder of the summer. (Environmental Partner 2019).

The Plymouth Planning Department has indicated that recent (pre-2019) growth is not sustainable and is expected to slow, as the area is nearing full built-out. Future developments and their estimated water demands are listed in **Table 15.8 (Environmental Partners 2017).**

Table15.8 Future Developments and Estimated Water Demand

Development	Additional ADD (GPD)	Expected Completion
800 Colony Place	27,907	2025
Newfield Estates	6,900	2025
150 Water Street	7,200	2025
Tonya Stump School	6,000	2025
Home Depot Drive	35,728	2025
104 Carver Road	9,190	2025
Plaza Way Hotel	7,489	2025
#1 Commerce Way	13,008	2025
30 Prestige Way	2,125	2025
Village at Sawmill Woods	41,760	2025
Beaver Dam Road	7,320	2025
Cordage Park Future	58,860	2025
Home Depot Drive Future	21,457	2025
Total	**152,019**	

Currently, the water supply can supply 8.17 MGD. This is enough capacity to meet the 6-year average MDD of 7.97 MGD (Environmental Partners 2019).

15.3 Issues and Concerns

15.3.1 Water Supply Issues

- Plymouth residents are concerned landscaping and agriculture cause excessive strain on Plymouth's groundwater sources and may impact longevity of water supply (MAPC 2019).
- Plymouth tested each pressure zone to determine if storage could meet peak hour demand and requirements for fire flow. Four of the six zones had insufficient storage for the peak hour. Three of the six zones did not have enough fire storage. These inadequacies were largely the result of high elevation areas within the deficient pressure zoned rather than undersized tanks (Environmental Partners 2019).

15.3.2 Water Quality Issues

According to the 2019 Water System Management Plan, Bradford WTP, Federal Furnace PS, and Lout Pond PS are known to succeed SMCL's for iron and/or manganese (Environmental Partners 2019).

PFAS

As of August 2023, Plymouth Water Divisions wells meets the EPA standards for PFAS. The highest concentration of PFAS detected was 2 ppt of PFOA at Wannos Pond Well. The majority of samples were Non-Detects (Town of Plymouth 2023).

15.3.3 Water Demand Issues

- In the 2019 Water System Master Plan, Environmental Partners estimated that Plymouth would struggle to meet their current WMA permit limits through 2030, especially in the year 2023 and 2028 (Environmental Partners 2019). As of 2022, they have not exceeded their permitted withdrawal (Plymouth Water Division 2022).

15.4 Water Supply Alternatives

- Plymouth plans to help protect water quality by updating stormwater infrastructure (MAPC 2020).
- Plymouth plans to acquire land for conservation to protect the water supply (MAPC 2019).
- Plymouth may consider adopting water conservation practices for new developments in its bylaws (MAPC 2019).
- Currently, there are no plans in place to acquire additional emergency water supplies (Martin 2024).

15.5 Questions

Questions answered by Kendra Martin via email on 5/2/2024 are shown in blue.

- Are there any additional supply or demand concerns? No
- What is the breakdown of water demands in Plymouth (commercial, residential, agricultural, etc.)? Residential – 75%, Residential Institution – 3%, Commercial - 10%, Industrial – 4%, Municipal – 8%
- Is the interconnections section correct? Are these one-way interconnections, two-way connections, or emergency connections? What is the capacity and source location for these? Is the water treated or raw? Are there any blending issues? Connections are emergency connections. Water is treated. Unknown capacity or blending issues
- Are there plans in place for additional emergency water supplies? Not at this time
- Are projections available on the amount of units and timing associated the MBTA Community requirements? Are there estimates of water usage for these units? Information is not currently available

15.6 References

Environmental Partners. 2019. Plymouth Water System Master Plan.

———. 2017. Evaluation of the Plymouth Water System.

Martin, Kendra. 2024. Email Response to Questions.

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———. 2018. Water Management Act #9P421239.01

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Plymouth Planning Board. 2006. Plymouth Massachusetts Master Plan.

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Town of Plymouth. 2023. https://plymouth-ma.gov/1317/Water-Quality

16.0 Plympton

16.1 Water Supply

The Town of Plympton does not have a public water supply and residents rely solely on private wells. Firefighting is dependent on pump trucks (BETA Group Inc. 2020).

One Senior housing facility is supplied with drinking water from Kingston and a few properties near an old dump are provided supplied with drinking water from Middleborough (Vasa 2024).

Every resident of Plympton uses a septic system (Vasa 2024).

16.2 Issues and Concerns

- There are concerns with water quality of private wells. With all homes depending on septic, the MVP listed the protections of water from septic leakage as a high priority action item. The town's Board of Health provides general PFAS information from the stated on the town website but does not include reference to PFAS concerns in their well owner's manual resource (Town of Plympton 2016a 2024).

16.3 Water Supply Alternatives

- With no public water supplies, a high priority item identified in the MVP was the need for a community well head action plan to support acquisition of a community well head and backup water supplies. The Open Space Committee has been discussing these issues. Following the MVP, efforts have begun to start looking at potential properties for community well heads. No landowners have been contacted about these actions at this time.
- As mentioned in the Plympton Open Space Plan, one of the objectives was to work with Board of Selectmen, Planning, Zoning, Health and other boards to adopt bylaws, regulations, and agreements that protect the water supply now and in the future (Town of Plympton 2016b). Following this plan, the Bylaw Review Committee helped update the Plympton Zoning Bylaws Section 300-8.3, Groundwater Protection Districts, at the town meeting on May 17, 2023. The following items are still in discussion with the Open Space Committee:
  - Protect Plympton's current water supply and prioritize and acquire land for future community wellheads.
  - Review DEP maps of town areas contributing to local water supply and fill in information gaps as needed.
  - Create a Water Study Committee of relevant town departments to determine if the town has adequately protected future community water supply wellheads.

16.4 Questions

Answers provided during interview with Brian Vasa and Gavin Murphy on May 28, 2024 are shown in blue.

- Are there any concerns about PFAS? Are there efforts to encourage homeowners to test their wells? PFAS testing has not been performed throughout Plympton.
- Is there any information on the number and location of private wells? The whole town is almost exclusively private well water and private systems. There are two exceptions: the Woodlands Apartments (on Kingston water), and properties close to the transfer station (on Middleborough water).
- Are projections available on the number of units and timing associated the MBTA Community requirements? Are there estimates of water usage for these units? 50 unit suggested for Plympton, but Town has not voted yet.

16.5 References

BETA Group Inc. 2020. MVP Community Resilience Program Resilience Building Report for Plympton Massachusetts.

Town of Plympton. 2024. PFAS Information. https://www.town.plympton.ma.us/sites/g/files/vyhlif1091/f/uploads/pfas_information.pdf

———. 2016a. Well Owner's Manual. https://www.town.plympton.ma.us/sites/g/files/vyhlif1091/f/uploads/well-owners-manual-updated-3-3-16.pdf

———. 2016b. Open Space and Recreation Plan 2016-2023.

Vasa, Brian. 2024. Individual Interview.

17.0 Stoughton

17.1 Water Supply

Approximately 97% of drinking water in Stoughton comes from their nine groundwater wells. The remaining 3% is from a connection to MWRA on Island Street (Stoughton Water Department 2022a).

Stoughton's two WMA registrations were renewed in April 2023 and are valid until April 2033. Stoughton has two registered withdrawal points within Boston Harbor: Muddy Pond and Harris Pond Well. Additionally, there are three registered withdrawal points in the Taunton River Basin: Fennel Well, McNamara Well, and Gurney Well (MassDEP 2023a, 2023b). Stoughton also holds a WMA permit which authorizes an additional 0.13 MGD in withdrawals from each basin and are summarized in **Table 17.1**.

Stoughton's Water System Master Plan also describes WMA maximum daily withdrawal limits (**Table 17.2**), although they do not provide a permit numbers.

Stoughton has an active Water Supply Continuation Agreement (WSCA) with MWRA that is set to expire in 2027. The agreement specifies that MWRA may provide Stoughton with an annual maximum of 419.75 MG and a daily maximum of 2.5 MGD over the term of their agreement (MWRA 2017). Stoughton MWRA connection currently only has a pumping capacity of 1.008 MGD, but there are plans to in increase this number to the permitted amount of 0.504 MGD (Velazquez 2024).

Table 17.1 Stoughton's Maximum Authorized Annual Average Withdrawal Compared with 2022 Usage

	2022 ASR	
Drinking Water Source	Average Daily Withdrawal (MGD)	Registered + Permitted[25] Withdrawal (MGD), 2023-2033
Boston Harbor	1.06	1.08 + 0.13 = 1.21
Taunton River Basin	0.75	1.14 + 0.13 = 1.27

Table 17.2 Stoughton's Authorized Maximum Daily Withdrawal Rate Compared with 2022 Usage

	2022 ASR	
Drinking Water Source	Max Day Volume (MG)	DEP Approved Max Day Volume (MG)
Harris Pond Well 2	0.887	0.864
Fennel Well 3	0.427	0.48
McNamara Well 4	0.636	0.32
Gurney Well 5	0.357	0.2

[25] Registered + Permitted: Registrations refer to established renewable water withdrawals established prior to 1988. Permitted withdrawals refer to WMA Permits issued for withdrawals beyond any registration amounts for ground or surface water sources in excess of an annual average of 100,000 gallons per day or 9 million gallons in any 3-month period.

	2022 ASR	
Pratts Court Well 6	0.228	0.504
Goddard Well 7	0.17	0.187
Muddy Pond Replacement Wellfield and Collection Wells	0.343	0.4
MWRA	0.29	2.5

Note: Red text = violation

17.1.1 Water Treatment

Table 17.3 describes Stoughton's five WTPs.

Table 17.3 Treatment Plants and Capacities (Stoughton Water Department 2022b)

Name	Capacity (MGD)	Source	Treatment
Muddy Pond WTP	0.4	Muddy Pond Replacement Wellfield and Collection Wells	Disinfection, corrosion control
Pratts Court WTP	0.504	Pratts Court Well 6	Corrosion control, organics removal, iron removal, disinfection
Plain Street WTP	0.912	Fennel Wells 3A and 3, Gurney Well 5, McNamara Well 4	Manganese removal, corrosion control, disinfection, iron removal
Goddard Pump Station	0.19	Goddard Well 7	Corrosion control, disinfection
Harris Pond Pump Station	0.86	Harris Pond Well 2	Disinfection, corrosion control

17.1.2 Water Storage

Table 17.4 summarizes Stoughton's storage capacity across four tanks.

Table 17.4 Storage Tanks and Capacities (Stoughton Water Department 2022b)

Name	Capacity (MG)	Storage Type
Oakland Street Storage Tank	0.95	Ground Level Storage Tank
Ash Street Storage Tank	1.3	Ground Level Storage Tank
Pleasant Street Storage Tank	2	Ground Level Storage Tank
Forest Road Storage Tank	10	Ground Level Storage Tank
Total	14.25	—

17.1.3 Water Distribution System

In 2022, 75% of drinking water went towards residential use and 21% towards commercial use (Stoughton Water Department 2022b). **Table 17.5** provides additional Information about the Stoughton's distribution system.

Table 17.5 Distribution System Information for the Town of Stoughton (Stoughton Water Department 2022b)

Distribution System Information	
Number of Service Connections	8,633
Number of Distribution Systems	1
Finished Water Storage Capacity (MG)	14.25
Pumping Capacity (gpm)	2,052
Total Miles of Water Mains	151
Estimated Volume (MG) Lost to Leaks	135.1

Environmental Partners completed a Drinking Water Infrastructure Needs Survey and Assessment in 2021. The survey includes an inventory of Stoughton's pipes, storage tanks, and treatment structures along with current and future water system projects (Environmental Partners 2021). Stoughton also has a Water System Master Plan with extensive detail about their distribution system (Environmental Partners 2022).

17.1.4 Interconnections

Stoughton has a connection with the MWRA, which the regularly use.

Stoughton's emergency connections are described in **Table 17.6**

Table 17.6 Emergency Interconnections to the Town of Stoughton (Velazquez 2024)

Interconnection	Note
Brockton to Stoughton	built in 1970's - never used & obsolete
Canton to Stoughton	last used around 2000
Stoughton to Avon	hydrant to hydrant
Randolph	hydrant to hydrant - flow is finished water & rate is unknown
Easton	hydrant to hydrant - flow is finished water & rate is unknown

17.1.5 Private Wells

According to 2024 correspondence with Stoughton there are approximately 1,087 residential wells.

17.2 Water Demand

Table 17.7 provides additional information about the town's water demand.

Table 17.7 Water Demand Information for the Town of Stoughton (Velazquez 2024)

2023 Demand Information	
MDD (raw)	2.75 MGD
ADD (raw)	1.75 MGD
UAW	4.9 %
RGPCD	44 gallons/person/day (2022)

Stoughton has reported less than 10% UAW since 2017. (Environmental Partners 2022).

Stoughton did not institute an outdoor watering restriction in 2022 or 2023. Per their renewed WMA permit Stoughton must implement these restrictions by 2025 (Stoughton Water Department 2022b).

Environmental Partners calculated water demand forecasts using a similar method in Stoughton's Water System Master Plan (Environmental Partners 2022). Projections for a 65 RGPCD and 10 UAW (65/10) scenario and 50 RGPCD and 10 UAW (50/10) scenario are shown in **Table 17.8**. The master plan provides more details about how these forecasts were calculated (Environmental Partners 2022).

Table 17.8 Water Demand Forecast for the Town of Stoughton

	65/10 Projected Demands		50/10 Projected Demands	
	ADD	**MDD**	**ADD**	**MDD**
2025	2.623	4.155	2.136	3.384
2030	2.696	4.271	2.207	3.496
2035	2.71	4.293	2.217	3.513
2040	2.723	4.314	2.228	3.53

Table 17.9 from Stoughton's Water System Master Plan provides a list of pending and approved new developments (2020 to 2030) and their anticipated water usage (Environmental Partners 2022).

Table 17.9 Estimated Daily Demand of Future Developments

Development	Status	Estimated Additional GPD	Estimated Completion Period
409 Canton Street	Approved	852	2020-2025
Washington & Freeman Street	Approved	2,555	2020-2025
200 Shuman Ave. Building Expansion	Approved	2,557	2025-2030
Lawler Lane Subdivision	Approved	1,633	2025-2030
Washington Street Lot 2	Approved	330	2025-2030
Milton CAT Facility	Pending	1,521	2025-2030
421 Page Street (Tofu Production Facility)	Pending	50,000	2025-2030
Capen Reynolds Farm	Pending	405	2025-2030
19 Camden Street Self Storage	Pending	512	2025-2030
1580 Turnpike Street	Pending	106	2025-2030
Total		**60,470**	

17.3 Issues and Concerns

17.3.1 Water Supply Issues

If Stoughton were cut off from MWRA, they would struggle to meet their MDD relying on just their own sources (Environmental Partners 2022).

17.3.1.1 Water Quality Issues

Stoughton has had water quality challenges at the well sources and in the distribution system, primarily related to iron and manganese. As such, they have taken action to improve water treatment via construction of Plain Street Water Treatment Plan and improve supply via construction of Muddy Pond Pump Station (Environmental Partners 2022).

Per- and Poly-Fluoroalkyl Substances

In the 2022 Annual Water Quality Report, PFAS6 concentrations of 4.4 to 25.4[27] ppt were recorded in the drinking water. The report states that two of the five sample locations, Muddy Pond WTP and Goddard Pond water stations, violated the 20 ppt standard set forth by MassDEP (Stoughton Water Department 2022a).

A comprehensive spreadsheet of PFAS breakdown at each well for sample between 2021 and 2023 was provided by Stoughton. **Table 17.10** shows an example sample from October 31, 2023.

Table 17.10 PFAS Breakdown from sampling on October 31, 2023 (Stoughton Water Department, n.d)

Site	PFBS	PFHxS	PFHpA	PFOA	PFOS	PFNA	PFDA	PFAS6
Muddy Pond	2.6	2.9	2.5	8.2	7.2	ND	ND	20.4
Harris Pond	2.5	3.1	2.4	6.3	4	ND	ND	15.8
Plain Street WTP	1.4	2.2	1.1	3.3	2.6	ND	ND	8.1
Pratts Court	1.5	2.6	1.6	5.3	5.3	ND	ND	13.4
Goddard	1.6	1.5	1.4	4.9	8.1	ND	ND	13

Note: Red text = violation; PFBS = Perfluorobutane sulfonate; PFHpA = Perfluoroheptanoic acid; PFHxS = Perfluorohexane sulfonate; PFOS = Perfluorooctane sulfonic acid; PFOA = Perfluorooctanoic acid; PFNA = Perfluorononanoic acid; PFDA = Perfluorodecanoic acid

Stoughton is currently bidding on a Muddy Pond Pump Station treatment construction. Another treatment plant for Pratts Court is being planned (Velazquez 2024).

17.3.1.2 Other Issues

A list of hazards within 2,000 feet of Stoughton's wells that could threaten the sources water quality is as follows (Environmental Partners 2022):

- Pratts Court underground diesel storage tank is within 255 feet from Pratts Court Well 6 and is a potential source of hydrocarbons and Volatile Organic Chemicals.
- A hospital complex is within 675 feet from Goddard Well 7 and is a potential source of various chemicals.
- Stoughton Youth Soccer field is within 1,500 feet from Muddy Pond Well 1 and is a potential source of nitrogen and phosphorus.

[27] Red text = violation

- Pushee Fields is 2,000 feet from Pratts Court Well 6 and is a potential source of nitrogen and phosphorous.

Stoughton has a surplus of volume for fire flow; however, none of it is considered usable to high elevation customers (Environmental Partners 2022).

17.4 Water Supply Alternatives

- There are no plans for an additional water supply, but there are plans to upgrade Pratts Court sources from 0.1 MGD to 0.504 MGD (Velazquez 2024).
- Environmental Partners recommend that Stoughton adopt a regular development cycle of three wells per year to prevent wells from going offline because of iron and manganese buildup (Environmental Partners 2022).

17.5 Questions

Answers from Email from Jaime Velazquez on 4/29/2024 are shown in blue.

- Were water bans/outdoor restrictions issued in 2023? No
- Why did you see a spike in UAW in 2022? unknown
- Is Muddy Pond Pump Station PFAS Preparedness Study (Environmental Partners 2021) completed? Yes, designed and being bid for construction now
- It is unclear that exact number of Stoughton's daily withdrawal limit from MWRA. According to their Water System Master Plan, the limit is 1.44 MGD, but according to their WSCA with MWRA, it is 2.5 MGD. Pump station only has ability to pump up to 700 GPM.
- How are you exceeding the operation capacity of your wells? Did you upgrade the pumps from 2022 to present? Yes on well 2; 2 others reported #'s look wrong (wells 4 & 5)
- Is the interconnections section correct? Are these one-way interconnections, two-way connections, or emergency connections? What is the capacity and source location for these? Is the water treated or raw? Are there any blending issues? Canton & MWRA; Avon, Randolph, Easton, are hydrant to hydrant.
- Are there plans in place for additional emergency water supplies? No, upgrade our own sources
- Is there information on the number of residents on private wells? Are approximate locations available? There is approximately 1087 residential wells. Approximate locations would be with the BOH dept
- Can you provide any future population estimates if the town uses a different source than University of Massachusetts Donahue Institute's projections? No
- What are the main nonresidential uses? Is it mainly commercial/industrial or municipal/institutional? Are there any projected increases or decreases in nonresidential demand? Commercial / Industrial

17.6 References

Environmental Partners. 2022. Water System Master Plan.

———. 2021. Drinking Water Infrastructure Needs Survey and Assessment.

———. 2021b. Emergency Response Plan.

Massachusetts Department of Environmental Protection (MassDEP). 2023a. Water Management Act Registrant Statement #41928502.

———. 2023b. Water Management Act Registrant Statement #42528502.

Massachusetts Water Resources Authority (MWRA). 2017. Water Supply Continuation Agreement.

Stoughton Water Department. 2022a. Annual Water Quality Report.

———. 2022b. Annual Statistics Report.

———. N.d. PFAS Report.

Velazquez, Jaime. 2024. Email Response to Questions

18.0 West Bridgewater

18.1 Water Supply

West Bridgewater draws from the Taunton River Basin via 7 groundwater wells in 4 locations. West Bridgewater's WMA Permit was renewed in 2021 and specifies a maximum authorized annual average withdrawal limit (**Table 18.1**) and maximum daily withdrawal rates for each well (**Table 18.2**).

Table 18.1 Average Daily and Registered + Permitted Withdrawals (MassDEP 2021, West Bridgewater Water Department 2022a)

	2022 ASR	Water Management Permit #9P-4-25-322.01	
Drinking Water Source	Average Daily Withdrawal (MGD)	Registered + Permitted[28] Withdrawal, 2021–2025 (MGD)	Registered + Permitted Withdrawal, 2025–2030 (MGD)
Taunton River Basin	0.65	0.73 + 0.08 = 0.81	0.73 + 0.11 = 0.84 (0.73 + 0.14 = 0.87*)

*With specific advance written approval from MassDEP, West Bridgewater is authorized to increase the maximum authorized annual withdrawal volume to 0.87 MGD prior to March 1, 2025, provided that West Bridgewater is meeting the following special permit conditions:

- Residential gallons per capita day below 65 gallons per person per day
- Unaccounted for water below 10% or all UAW function equivalence requirements
- Seasonal limits on nonessential outdoor water use
- Water conservation requirements (West Bridgewater Water Department 2021)

These special permit conditions were met in 2022 (MassDEP 2022).

Table 18.2 West Bridgewater's Maximum Daily Withdrawal Rate Compared with 2022 Usage (MassDEP 2021, West Bridgewater Water Department 2022a)

	2022 ASR	WMA Permit #9P-4-25-322.01
Drinking Water Source	Maximum Daily Withdrawal (MGD)	Maximum Daily Rate (MGD)
Station One Cyr Street Well 1a and Cyr Street Well 1b	0.209	1.01 (combined)
Station Two Norman Avenue Well 2	0.639	0.72
Station Three Manley Street Well 3a and Manley Street Well 3b	0.468	0.72 (combined)
Station Four Cyr Street Well 4 and Cyr Street Well 5	0.576	0.72 (combined)

[28] Registered + Permitted: Registrations refer to established renewable water withdrawals established prior to 1988. Permitted withdrawals refer to WMA Permits issued for withdrawals beyond any registration amounts for ground or surface water sources in excess of an annual average of 100,000 gallons per day or 9 million gallons in any 3-month period.

18.1.1 Water Treatment

West Bridgewater operates five WTPs.

Table 18.3 outlines the plants.

Table 18.3 West Bridgewater Treatment Facilities (West Bridgewater Water Department 2022a)

Treatment Facility	Sources	Treatment	Capacity (MGD)
Manley Street Treatment Plant	Manley Street Well 3A River and Manley Street Well 3B Driveway	Iron removal, disinfection, corrosion control, PFAS	0.72
Cyr Station 4	Cyr Street Well 5A and Cyr 4	Corrosion control, disinfection	UNK
Cyr Station 1	Cyr 1A and Cyr 1B	Corrosion control, disinfection	UNK
Norman Station 2	Norman 2	Corrosion control	UNK

18.1.2 Water Storage

West Bridgewater operates three storage facilities, as outlined in **Table 18.4.**

Table 18.4 West Bridgewater Storage Facilities (West Bridgewater Water Department 2022a)

Storage Facility	Capacity (MG)	Storage Type
Walnut Street Tank	1	Elevated
Spring Street Tank 1	0.5	Ground level
Spring Street Tank 2	5	Ground level

18.1.3 Water Distribution System

Within West Bridgewater's water distribution system, there are approximately 65 miles of water main and approximately 2,600 connections (CDM Smith/Weston & Sampson 2022). **Table 18.5** outlines further information detailing the West Bridgewater distribution system.

Table 18.5 West Bridgewater Water Distribution System (West Bridgewater Water Department 2022a)

Distribution System Information (2022)	
Number of Service Connections	2,901
Number of Distribution Systems	1
Finished Water Storage Capacity (MG)	6.5
Pumping Capacity (gpm)	1,730
Total Miles of Water Mains	69
Estimated Volume (MG) Lost to Leaks	UNK

During 2018, there was a major leak in the water distribution system that caused a significant increase in UAW. It is assumed that the leak was repaired.

18.1.4 Interconnections

According to Wayne Parks, West Bridgwater is not connected to Easton's distribution system. Easton owns a 12" Ductile Water Main on Turnpike St, which West Bridgewater has no connection to this pipe. Easton supplies the water to the pipe and feeds West Bridgewater and Easton Customer's along Turnpike St. Easton bills the West Bridgewater Water Dept. for these customers and West Bridgewater bills the customers. Approximately 15-20 houses fed on Turnpike St (Parks 2024). This is why Easton recorded having sold 658,164 gallons to West Bridgewater in their 2022 ASR (Easton Water Division 2022).

Brockton feeds two houses on Samuel Ave in West Bridgewater but the water main is a dead-end (Parks 2024).

West Bridgewater has no connections to Bridgewater, or East Bridgewater (Parks 2024).

18.1.5 Private Wells

West Bridgewater reports that there 12+ residents are not connected to their distribution system (Parks 2024).

18.2 Water Demand

Table 18.6 provides water demand information for West Bridgewater.

Table 18.6 West Bridgewater Demand Information (West Bridgewater Water Department 2022a)

Demand Information	
MDD (raw)	1.15 (MG)
ADD (raw)	0.65 (MGD)
UAW	9.8%
RGPCD	51 gallons/person/day

In accordance with their WMA permit, West Bridgewater has seasonal limits on nonessential outdoor water use**.**

Growth projections show that West Bridgewater's buildout demand of water is 3.15 MGD. This exceeds the current system capacity (CDM Smith/Weston and Sampson 2012). DCR created a water needs forecast for West Bridgewater, as outlined in **Table** (MassDEP 2021).

Table 18.7 Department of Conservation and Recreation Water Needs Forecast (MassDEP 2021)

Permit Period	Water Needs Forecast Assuming RGPCD 65/UAW 10%	Water Needs Forecast Assuming Current Trend RGPCD/UAW
2020–2025	0.81	0.79
2026–2030	0.83	0.80
2030 + 5% Buffer	0.83 + 0.04 = 0.87	0.80 + 0.04 = 0.84

18.3 Issues and Concerns

18.3.1 Water Quality Issues

- The wells on Cyr Street are subject to groundwater pollution, and West Bridgewater plans to address this by conduction a study of treatment options and nature-based solutions in recharge areas (Tighe & Bond 2022).
- The Norman Avenue Well is approved for a pilot study to determine treatment options and update the treatment system (Tighe & Bond 2022).
- West Bridgewater also had several routine water quality samples exceed the acceptable level of coliform bacteria in 2022. To remedy this issue, West Bridgewater increased the level of chlorine and the sites passed retesting for coliform bacteria (West Bridgewater Water Department 2022b).
- According to 2023 Water Quality Report, Manley Street well sometimes exceeded the MCL for perfluorocarbons (West Bridgewater Water Department 2023).

Per- and Poly-Fluoroalkyl Substances

- A PFAS filter was installed at Manley Street Treatment plant in 2023 and has successfully brought PAS concentration down to 0 ppt (West Bridgewater Water Department 2023).
- Stations 1, 2, and 4 experienced PFAS concentrations ranging from 2.96 ppt to 7.25 ppt between 2022 and 2023 (West Bridgewater Water Department 2023).

18.3.2 Other Issues

- West Bridgewater Water Department is enterprise funded and is separate from the town. Therefore, they are often left out of town discussion on the new MTBA community requirements. There is concern that if development were to occur rapidly, that the water department would not have capacity to support.

18.4 Water Supply Alternatives

- West Bridgewater is considering conducting a vulnerability study to determine stresses on the water system caused by a drop in the water table and increased water demand (Tighe & Bond 2022).
- West Bridgewater is interested in nature-based solutions that can reduce pollution in aquifer recharge areas and West Bridgewater's water protection district (Tighe & Bond 2022).
- West Bridgewater also seeks to augment their current groundwater supply with a bedrock supply well. This will help the town meet demand projections (CDM Smith/Weston & Sampson 2022). There are three sites where a new well could be developed. Cyr St, North Elm St, and Norman Ave (Parks 2024).
- West Bridgewater voters approved a pilot study to explore Iron/Manganese/ and PFAS issues at the Normal Ave and Cyr St wells (West Bridgewater Water Department n.d). The plan is to build one plant to treat the 5 wells combined.

- West Bridgewater is looking into possible interconnections for emergency situations (Parks 2024).

18.5 Water Demand Alternatives

- West Bridgewater is looking at water rate increases and implementing a third-rate tier to reduce water demand (Parks 2024).

18.6 Questions

Questioned answered by Wayne Parks on 4/25/24 are shown in blue.

- Are there any actions being considered to reduce water demand? Looking at a Water Rate Increase and implementing a Third Rate Tier.
- Does town purchase from Easton annually? We do not purchase water from Easton. West Bridgewater owns a 12" Ductile Water Main on Turnpike St. At this time West Bridgewater has no connection to this pipe. Easton supply's the water to the pipe and feeds West Bridgewater and Easton Customer's along Turnpike St. Easton bills the West Bridgewater Water Dept. for these customers and West Bridgewater bills the customers.
- Was a pilot study conducted for the Norman Avenue Well? A pilot study was conducted on Cyr St Wells 1A & 1B, and Norman Ave Well 2. We applied to the SRF Grant and have made the list. A Treatment Plant combining Cyr St Wells 1A, 1B, 4, and 5A plus Norman Ave Well 2 is in the design stage.
- Is the interconnections section correct? Are these one-way interconnections, two-way connections, or emergency connections? What is the capacity and source location for these? Is the water treated or raw? Are there any blending issues? We have No Interconnections.

  In Brockton, Samuel Ave has 2 houses in West Bridgewater but the Water Main a dead-end is fed by Brockton.

  In Easton, Turnpike St the Water Main is in West Bridgewater and is a dead-end. It is fed by Easton. We have about 15-20 houses fed by it.

  We have no connections to Bridgewater, or East Bridgewater.
- Are there plans in place for additional emergency water supplies? There are three sites where a new well could be developed. Cyr St, North Elm St, and Norman Ave. We are also looking at possible interconnection for emergency situations.
- Is there information on the number of residents on private wells? Are approximate locations available? yes
- Are projections available on the amount of units and timing associated the MBTA Community requirements? Are there estimates of water usage for these units? The Water Dept is Enterprise Funded. We are separate from the town. The Town does not include us in these

discussions. If they do it correctly this would be a non-issue. With any build out occurring slowly. The Water Dept would not have capacity for a full roll out of this requirement.

18.7 References

CDM Smith/Weston & Sampson. 2012. Upper Taunton River Regional Wastewater Evaluation.

Easton Water Division. 2022. Annual Statistics Report.

Massachusetts Department of Environmental Protection (MassDEP). 2021. Water Management Act Permit

Old Colony Planning Council. 2001.West Bridgewater Master Plan Implementation.

Tighe & Bond. 2022.West Bridgewater MVP Summary of Findings.

Parks, Wayne. 2024. Email Response to Questions.

West Bridgewater Water Department. 2024. West Bridgewater PFAS Information Page.

———. 2023. Annual Water Quality Report

———. 2022a. Annual Statistics Report

———. 2022b. Annual Water Quality Report

———. n.d. Water Project

19.0 Whitman

19.1 Water Supply

Whitman purchases 100% of their drinking water from the City of Brockton. They do not have any sources of their own. Brockton also serves Whitman's municipal sewer system. They are allowed to transfer an annual average daily flow of 1 MGD to Brockton's Wastewater Treatment Facility (OCPC 2021).

19.1.1 Water Treatment

Table 19.1 describes Whitman's only treatment plant.

Table 19.1 Treatment Plants and Capacities (Town of Whitman 2019)

Name	Capacity (MGD)	Source	Treatment
Bedford Street Chlorine Booster	1	Brockton Water	—

19.1.2 Water Storage

Whitman has no storage capacity.

19.1.3 Water Distribution System

In 2019, 88% of Whitman's water went towards residential use and 11% went towards commercial use (Town of Whitman 2019). **Table 19.2** provides information about the Whitman's distribution system.

Table 19.2 Distribution System Information for the Town of Whitman (Town of Whitman 2019)

2019 Distribution System Information	
Number of Service Connections	4,451
Number of Distribution Systems	1
Finished Water Storage Capacity (MG)	0
Pumping Capacity (gpm)	0
Total Miles of Water Mains	65
Estimated Volume (MG) Lost to Leaks	37.6

19.1.4 Interconnections

The Town of Whitman only has interconnections with the City of Brockton. Brockton's Silver Lake system supplies Whitman's water and is released to the town through metered gates at Bedford Street and Temple Street (OCPC 2021).

19.1.5 Private Wells

The town keeps a list of potable wells available online. [29] It does not have any entries after 2001.

19.2 Water Demand

Table 19.3 provides water demand details from 2019.

Table 19.3 Water Demand Information for the Town of Whitman (Town of Whitman 2019)

2019 Demand Information	
MDD (raw)	2.46 MGD
ADD (raw)	0.85 MGD
UAW	14.6%
RGPCD	43 gallons/person/day

Note: Red Text = Violation

The town has exceeded 10% for UAW. Unlike other towns, Whitman is not required to institute a nonessential water restriction (Town of Whitman 2019).

DCR's forecast projections were not provided for Whitman.

19.3 Issues and Concerns

19.3.1 Water Supply Issues

- **Section 6.0**, Brockton, provides information on additional water supply issues.

19.3.1.1 Water Quality Issues

- **Section 6.0**, Brockton, provides information on additional water quality issues.

Per- and Poly-Fluoroalkyl Substances

- PFAS6 in drinking water sources from Brockton were only 2.8 ppt in 2021 (Town of Whitman 2022).

19.4 Water Supply Alternatives

- One of the goals mentioned in Whitman's MVP Plan is to "research options, cost, funding, and acquisition of back up water resources including increasing storage capacity" (OCPC 2021).
- Another goal is to investigate the need for emergency water supply interconnection and to "work with the City of Brockton and other stakeholder to reduce reliance on Monponsett Pond and Silver Lake for drinking water supply to restore more natural flows to the water system" (OCPC 2021).

[29] https://www.whitman-ma.gov/DocumentCenter/View/87/Town-of-Whitman-Potable-Wells?bidId=

- According to Whitman’s MVP, there are a lot of properties that are connected to town water for irrigation (OCPC 2021).

19.5 Questions

No Answers Provided

- According to Whitman’s MVP, there are a lot of properties that are connected to town water for irrigation (OCPC 2021). Are there periods of time where there are outdoor bans? While Whitman does not have its own water permit, is it still subject to outdoor use restrictions listed in the Water Management Act?
- Are there any other interconnections in addition to Brockton? Are these one-way interconnections, two-way connections, or emergency connections? What is the capacity and source location for these? Is the water treated or raw? Are there any blending issues?
- Are there plans in place for additional emergency water supplies?
- Is there information on the number of residents on private wells? Are approximate locations available?
- Does Whitman have projections for future demand?
- Can you provide the town’s historical population data and water use from 2000 to present?
- Can you provide any future population estimates if the town uses a different source than University of Massachusetts Donahue Institute’s projections?
- What are the main nonresidential uses? Is it mainly commercial/industrial or municipal/institutional? Are there any projected increases or decreases in nonresidential demand?
- Are projections available on the amount of units and timing associated the MBTA Community requirements? Are there estimates of water usage for these units?

19.6 References

Old Colony Planning Council (OCPC). 2021. Municipal Vulnerability Preparedness and Hazard Mitigation Plan.

Town of Whitman. 2022. Annual Water Quality Report.

———. 2019. Annual Statistics Report.

Appendix B Future Risks to OCPC Regional Hydrology and Water Availability

Appendix B Future Risks to OCPC Regional Hydrology and Water Availability

B.1 Purpose

The goal of this analysis was to determine if the range of projected climate trends in Southeastern Massachusetts could result in reduced occurrence of naturally available water, both in surface streams and in groundwater, especially during traditionally low flow periods. Additionally, the analysis aimed to quantify future statistical trends in regional droughts, so that water management alternatives evaluated in this Plan could be considered in the context of whatever risks might materialize.

B.2 Historical Hydrology

To evaluate the potential risks associated with future changes and impacts on water availability, it is first necessary to understand the current and historical hydrology of the region. To do so, hydrologic data were collected, and a simple model that relates monthly precipitation and air temperature to streamflow and groundwater variations was developed.

Most of the OCPC region is within the Taunton River Watershed, while the eastern portion lies within the South Coastal watershed. There is one USGS streamflow gauge in each watershed. In the South Coastal Basin, USGS 01105870 is located on the Jones River in Kingston, MA, and in the Taunton River Basin, USGS 01108000 is located on the Taunton River in Bridgewater, MA. **Figure B-1** shows the location of these gauges relative to the OCPC region and key watersheds. **Figure B-2** illustrates the long-term daily streamflow records in the Taunton River near Bridgewater, and the Jones River at Kingston from December 1997 through August 2022. Periods with data gaps were not used for calibration of models.

Also shown in **Figure B-1** are four USGS groundwater monitoring wells. Groundwater data from these locations can serve as proxies for regional streamflow patterns and groundwater fluctuations. **Figure B-3** shows the data for these four groundwater wells and their corresponding fluctuation of the water table levels beneath the local ground surface. Some of the wells oscillate much more than others, suggesting that these may be closer to the influence of water supply wells. While not centrally located in the region, the two wells in Duxbury (Duxbury 79R) and Plymouth (Plymouth 22) are probably the most representative of natural groundwater rise and fall over a sufficiently long historical period to formulate relationships with precipitation and temperature.

Neither the surface water traces nor the groundwater fluctuations in **Figures B-2** and **B-3** suggest long-term increases or declines in water availability, but rather, a hydrologic system that has responded to rainfall, temperature, and water use seasonally and reasonably stable.

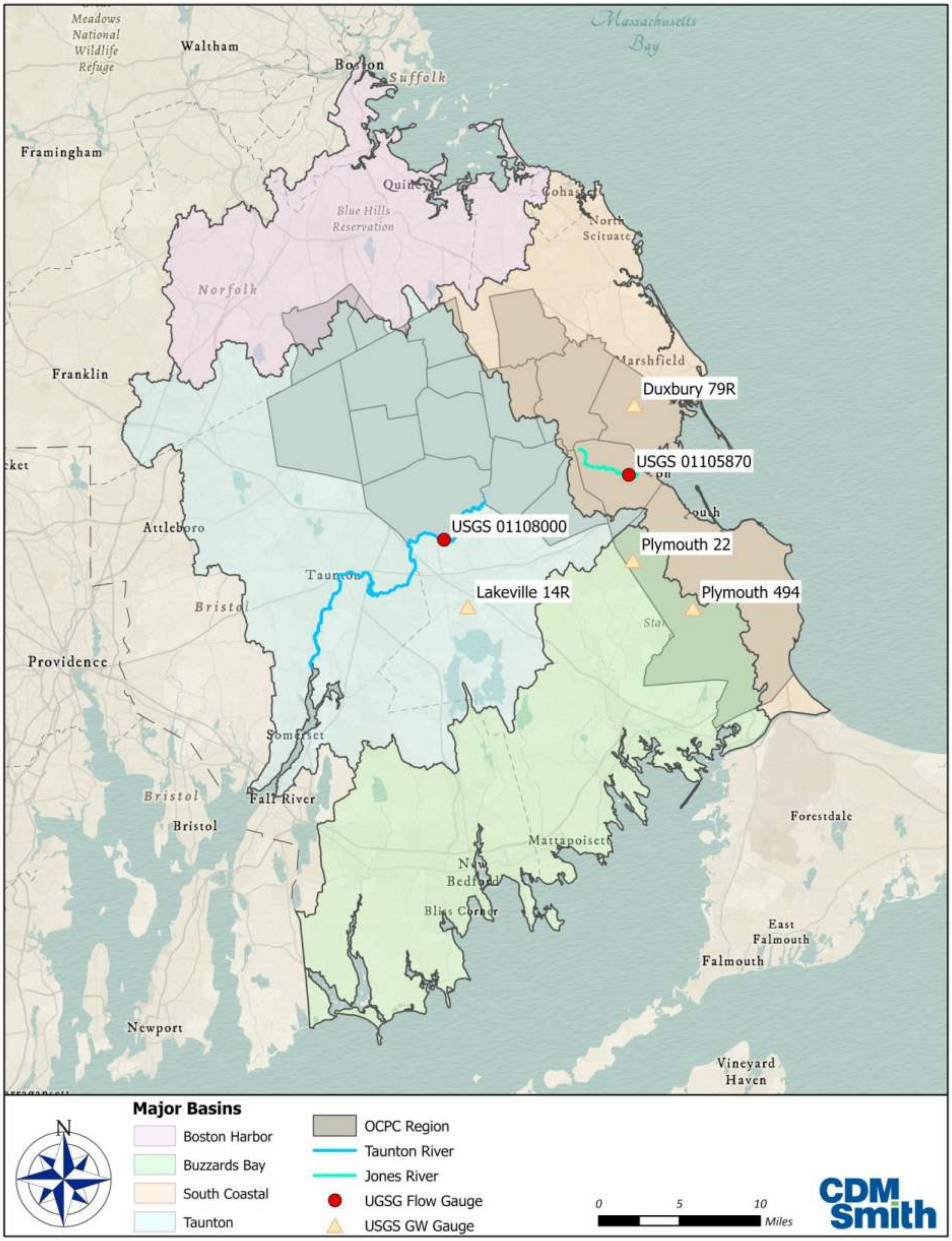
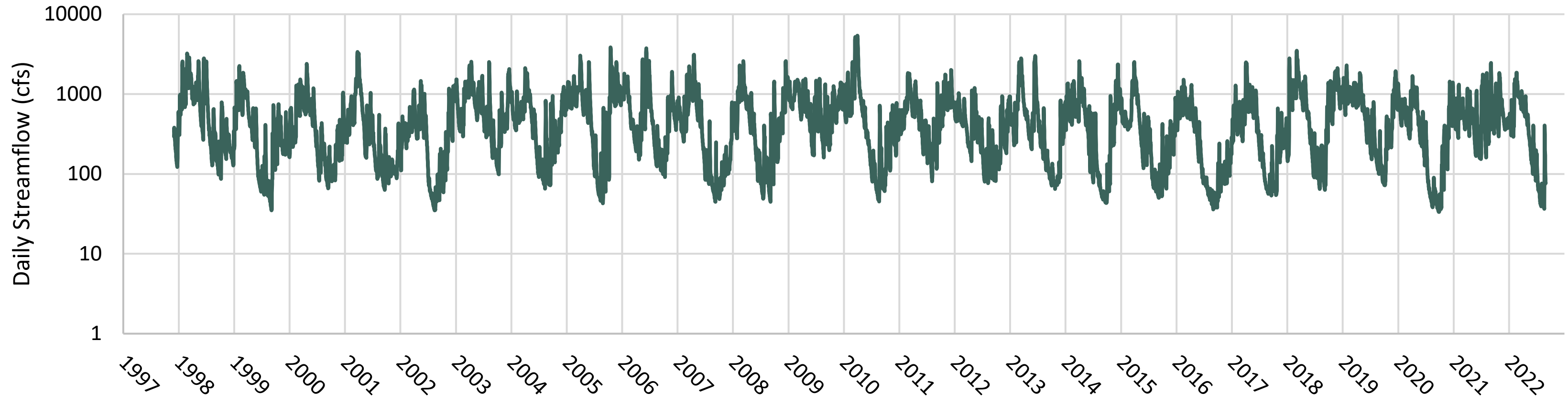


Figure B-1: OCPC Region and Key Watersheds

A. USGS 01108000 Taunton River near Bridgewater MA



B. USGS 01105870 Jones River at Kingston MA

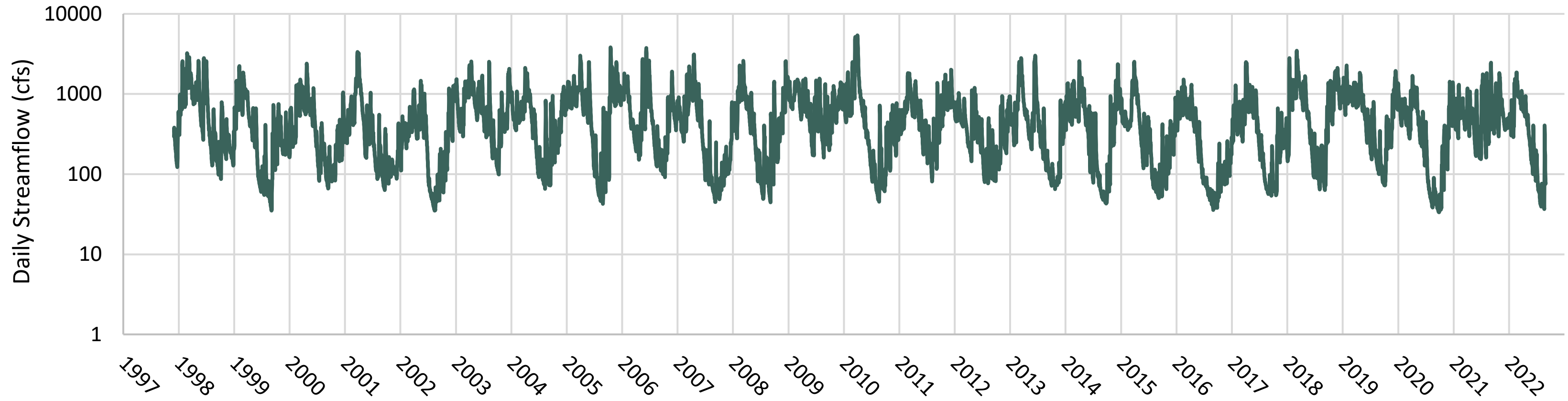


Figure B-2: Representative Regional Hydrology in the OCPC Region

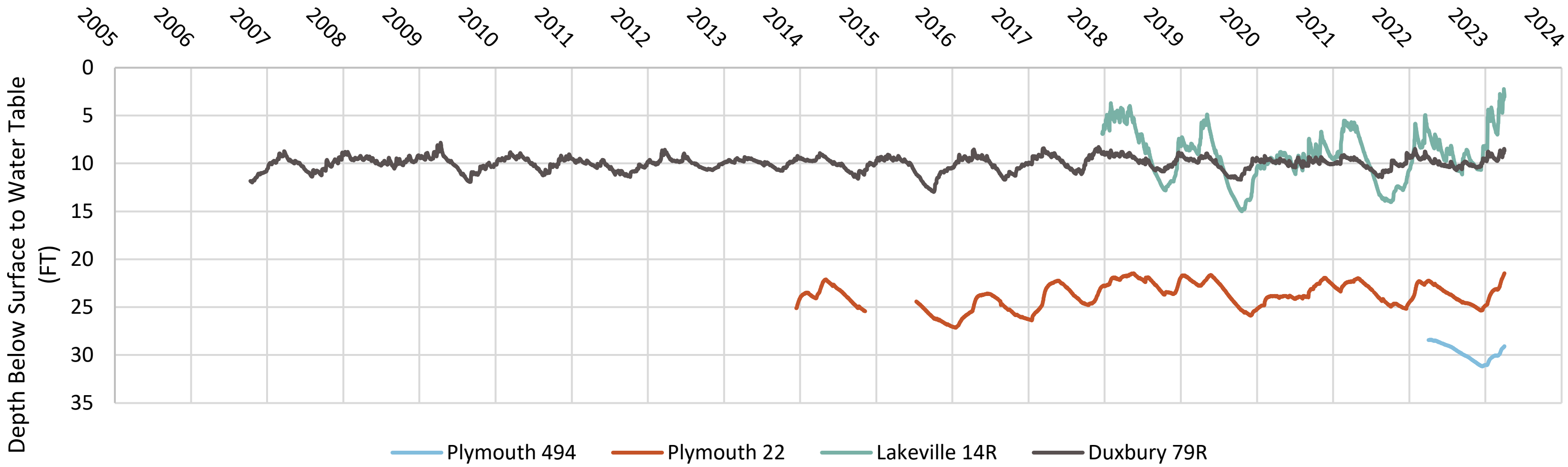


Figure B-3: Groundwater Monitoring Wells in the Vicinity of the OCPC Region

B.3 Water Balance Model

To test the response of surface water flows and groundwater levels to future climate variables, a simple but proven water balance model was developed and tested against historical patterns. The “abcd” model is often employed as a four-parameter (a, b, c, and d) model for rainfall/runoff/infiltration simulation that evaluates surface water flow and generalized groundwater storage in response to timeseries of precipitation and temperature. For application for this project, seven parameters were used, the additional 3 parameters are Snow Melt Rate (e), Snow Melt Temperature (Tb), and Soil Porosity (P). For additional background and equations used in the “abcd” model, refer to Improved methods for national water assessment, water resources contract WR15249270 (Thomas Jr. 1981).

The semi-physically based parameters represent hydrologic response functions and two state variables that are pertinent to this study; shallow soil moisture and shallow groundwater that can create baseflow in streams. Four of the parameters, “a, b, c, and d” represent the ability of the soil to absorb rainwater (a, and b), the ratio of to water running off quickly from soil moisture to the water infiltrating to shallow groundwater beneath the upper soils (c), and the percentage of total water in the ground lost to streams or bedrock in each timestep (d). The additional parameters of e (snow melt rate), Tb (temperature above which any accumulated snow melts at rate e), and P (the porosity of the soil, used in this case to convert total groundwater into equivalent vertical elevations) are included in this application of the “abcd” model to account for the snowy climate, and the need to distribute water vertically in the groundwater.

The model has been shown to work particularly well in largely pervious watersheds or regions. The principal model parameters and functions are illustrated in **Figure B-4**, and explained in **Table B-1**, which also includes the final calibrated parameter values for the Taunton and Jones River Watersheds (visualized in **Figures B-5** through **B-7**). The models were developed with a monthly timestep.

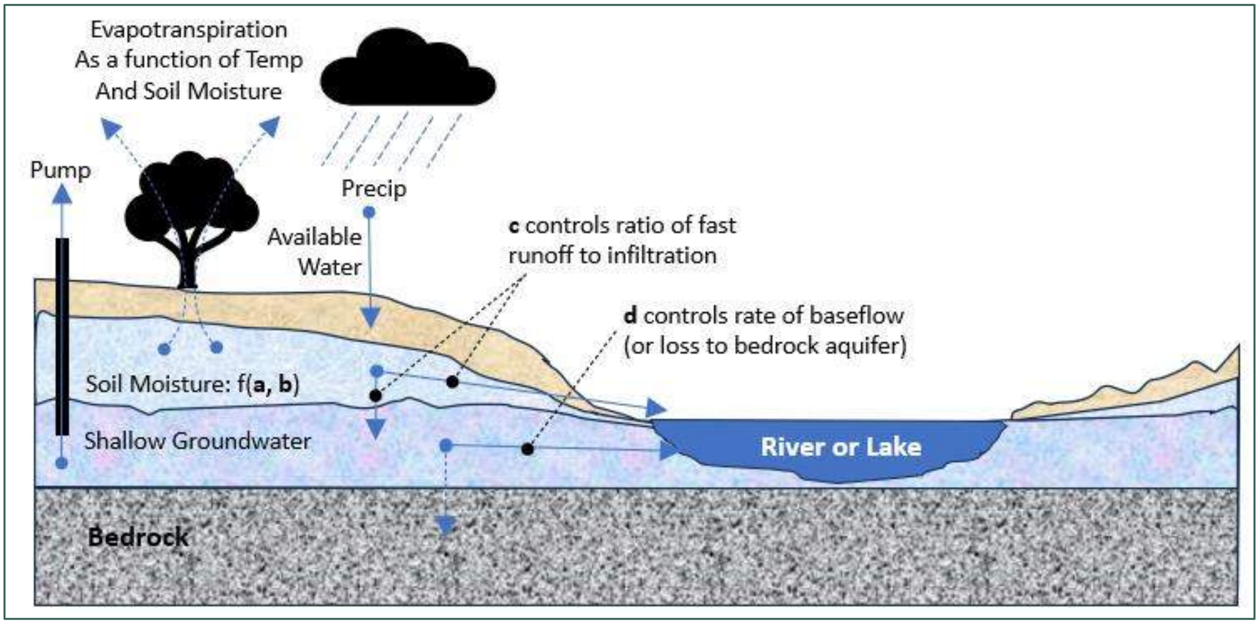


Figure B-4: Conceptual Diagram of Water Flow and Storage Simulated in the abcd Model

Table B-1: Parameters in the Monthly abcd Model

Parameter	Description	Plausible Values	Calibrated Value: * Taunton River	Calibrated Value: * Jones River
a	Controls the amount of runoff and recharge that can occur when soils are undersaturated.	0-1: Close to 1 in flat areas, less than 1 in hilly areas	**0.985**	**0.908**
b	Saturation level of the soils, in equivalent inches of water	0 - ~45	**5.06**	**13.11**
c	Ratio of groundwater recharge to surface runoff. Note that for watersheds that are very flat and not highly impervious, this value tends to be at or near 1 (meaning that most or all water that infiltrates into the upper soil will infiltrate deeper rather than run off directly)	0 = all runoff 1 = all recharge Anything in between divides water proportionally	**0.71**	**0.73**
d	Rate of groundwater discharge as a percentage of total groundwater storage in each monthly timestep	0 - 1	**0.90**	**0.90**
e	Snow melt rate: Effectively, the number of millimeters per degree above the melt temperature (Tb) to melt in a timestep	Varies based on the length of timestep	**50**	**11.5**
Tb	Melt Temperature: Effectively, the degrees Celcius above which snow will melt.	Near zero	**-4.81**	**-6.81**
P	Soil porosity, to convert total inches of water in the ground to actual relative depth in soil.	~0.1 – ~0.5	**0.19**	**0.16**

*See calibration results in **Section B.4.2**

B.3.1 Historical Climate Data

To establish a working baseline model of historical hydrology, the data sources in **Table B-2** were utilized. The input data includes daily precipitation and temperature, streamflow, and groundwater levels.

Table B-2: Data Sources

Data Type	Source	Dates Used	Specific Sites	Links or Notes
Daily Precipitation and Air Temperature	NOAA	1997-2022	**Taunton, MA**: USW00054777	https://www.ncei.noaa.gov/pub/data/ghcn/daily/all/USW00054777.dly
			Plymouth, MA USC00198367	https://www.ncei.noaa.gov/pub/data/ghcn/daily/all/USC00198367.dly
Streamflow	US Geological Survey	1997-2022	USGS 01108000 TAUNTON RIVER NEAR BRIDGEWATER, MA	https://waterdata.usgs.gov/nwis/dv/?site_no=01108000&PARAmeter_cd=00060
			USGS 01105870 **JONES RIVER** AT KINGSTON, MA	https://waterdata.usgs.gov/nwis/dv/?site_no=01105870&PARAmeter_cd=00060
Groundwater Levels	US Geological Survey	2022-2023	**PLYMOUTH, MA:** USGS 415217070393102 MA-PWW 494	https://waterdata.usgs.gov/nwis/uv/?referred_module=gw
		2014-2024	PLYMOUTH, MA: USGS 415453070434901 MA-PWW 22	
		2018-2024	LAKEVILLE, MA: USGS 415229070554301 MA-LKW 14R	
		0007-2024	DUXBURY, MA: USGS 420316070433501 MA-D4W 79R	

B.3.2 Model Calibration

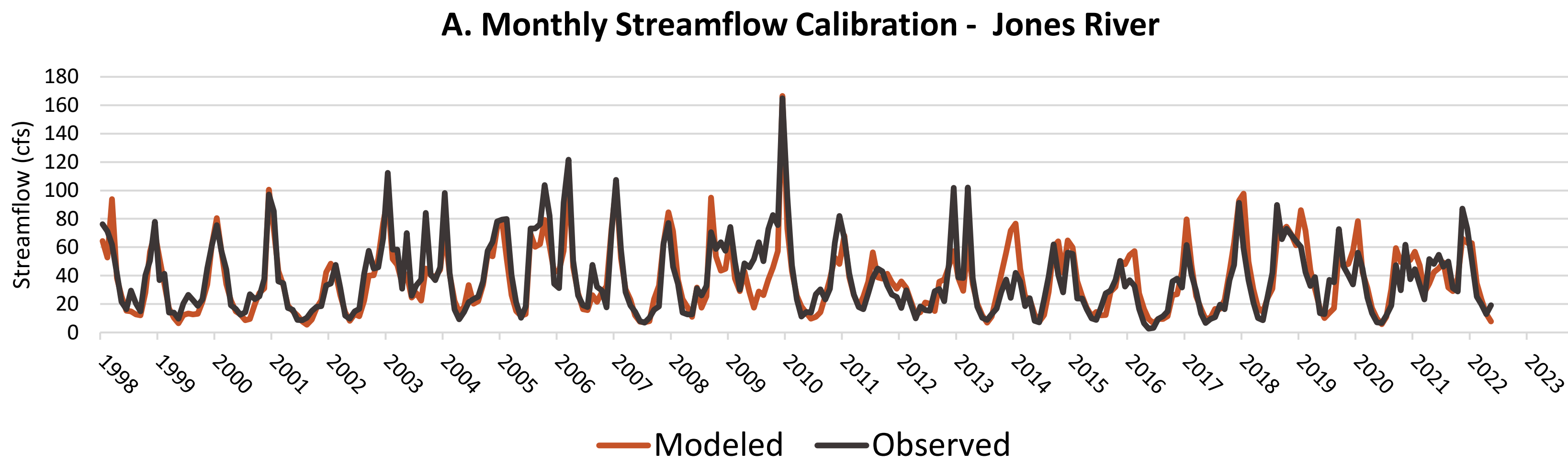
The *abcd* models were calibrated using the precipitation and temperature data in the table above (inputs) and compared against observed streamflows and groundwater levels in the table above (outputs). The ultimate intended use of the two models, one for the Taunton River and one for the Jones River, was to evaluate potential shifts in flow statistics due to future climate patterns. As such, both the month-to-month precision of model performance and overall statistics were evaluated against historical observations.

The following observations were compiled into a determination that the two models are credible and useful for studying future climate impacts on streamflow and groundwater levels:

- **Figure B-5** illustrates the simulated vs. observed streamflow in the two models for the period of record. The "goodness of fit" statistic (R^2) is 0.80 for the Taunton River model, and 0.74 for the Jones River Model, and subjectively within the field, these qualify the models as useful to good for future scenario evaluation.

- **Figure B-6** illustrates the percentiles of flow for both simulated and observed data. Both models exhibit very good matches of observed data, with the only significant discrepancy being the absolute minimum monthly flow in the Jones River over the period of record (5.4 cfs simulated vs. 2.7 cfs observed – generally within the margin of error given that flows between the 5th and 90th percentile range from approximately 9 cfs to 73 cfs). Confidence in low flow predictive ability for both models is established by the 1st percentile simulated flows being within 2.6% and 0.5% of the observed values (Taunton and Jones, respectively), and the 10th percentile simulated flows being within 1.8 and 0.8% of observed values, respectively.
- **Figure B-7** illustrates that the simulated rise and fall of the water table generally follow long-term month-to-month trends (elevations are normalized to a common ground-level datum). Some of the observed groundwater levels exhibit higher amplitudes of fluctuation, but these are deemed to be influenced by water withdrawal wells. The long-term gage in Duxbury is used as a proxy for the general groundwater response over the watershed.
- Qualitatively, the timing and magnitude of simulated streamflow peaks and recession match observations very well.
- Likewise, the timing and amplitude of groundwater drawdown and recovery patterns match observed patterns well, including periods of sustained high levels (2021-2022), with the important exception that the model is limited in its ability to reproduce extreme drawdown due to its inherent structure, in which groundwater volume is a state variable that can be fully depleted mathematically. This is seen in the droughts that occurred in 2016 and 2020. This observation provides caution that the models should not be used to confidently project the patterns of extreme future groundwater drawdown. However, the models can be confidently applied to project future patterns of low streamflow.

Overall, the models are deemed to be useful tools for examining future streamflow patterns under any scenario, and groundwater patterns under wetter scenarios.



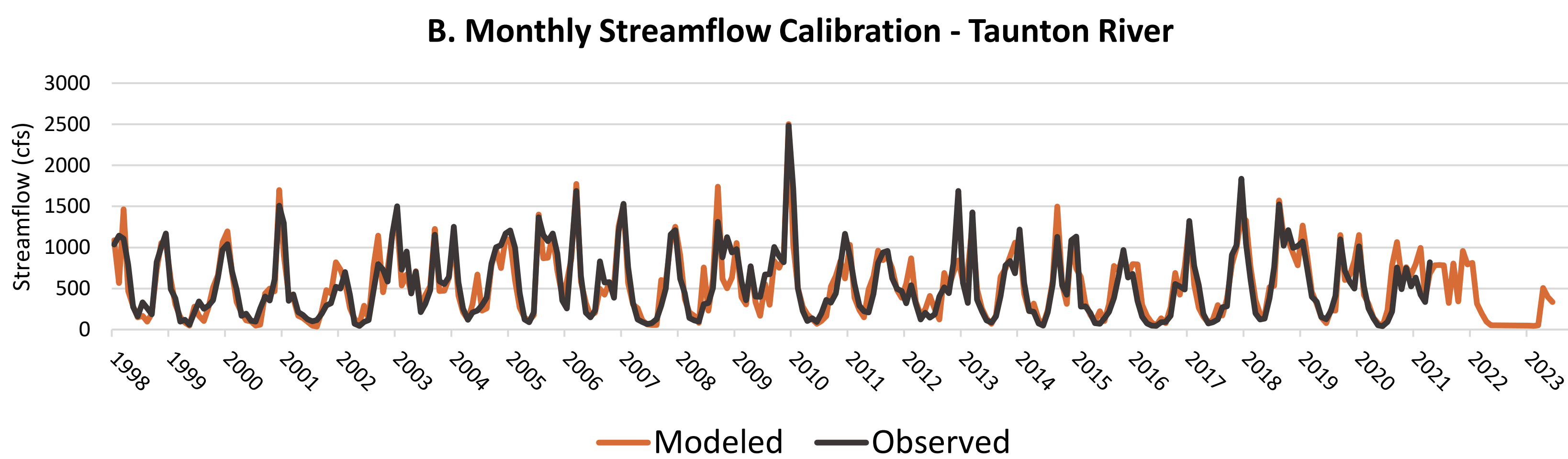
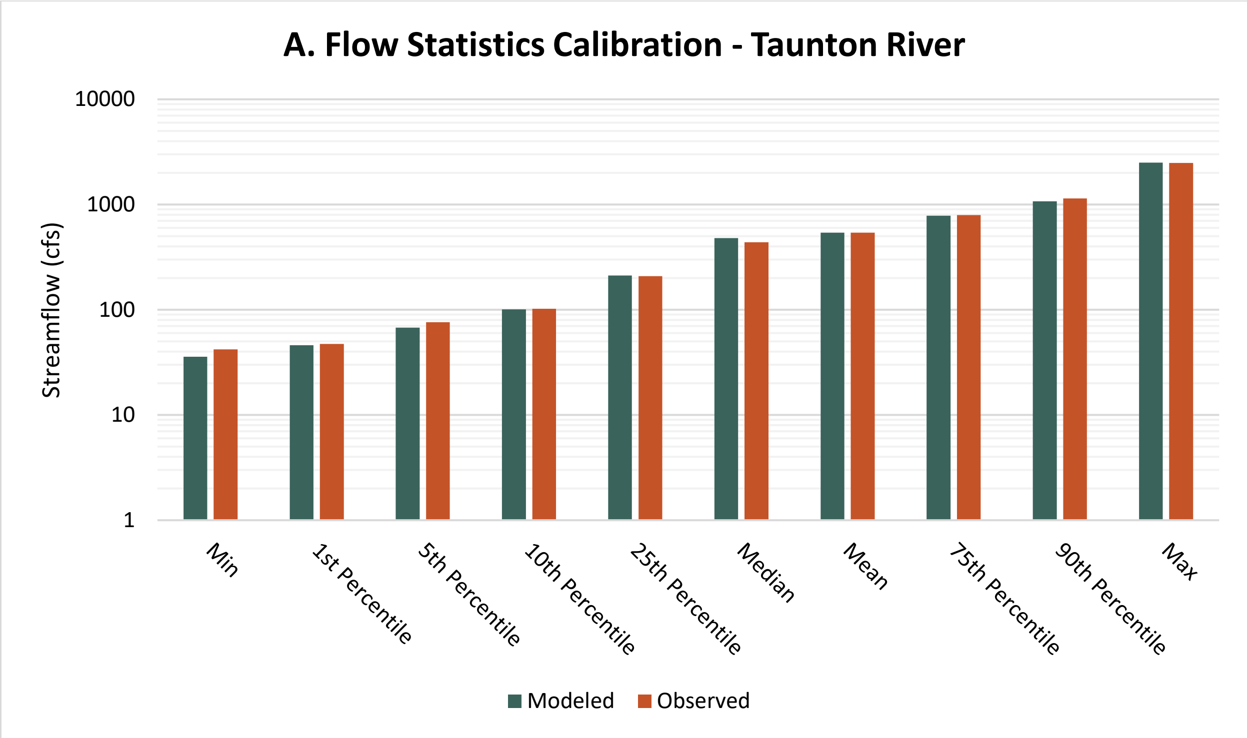


Figure B-5: Calibrated Water Balance Model Using Historic Precipitation and Temperature to Reproduce Historical Surface Water Flows



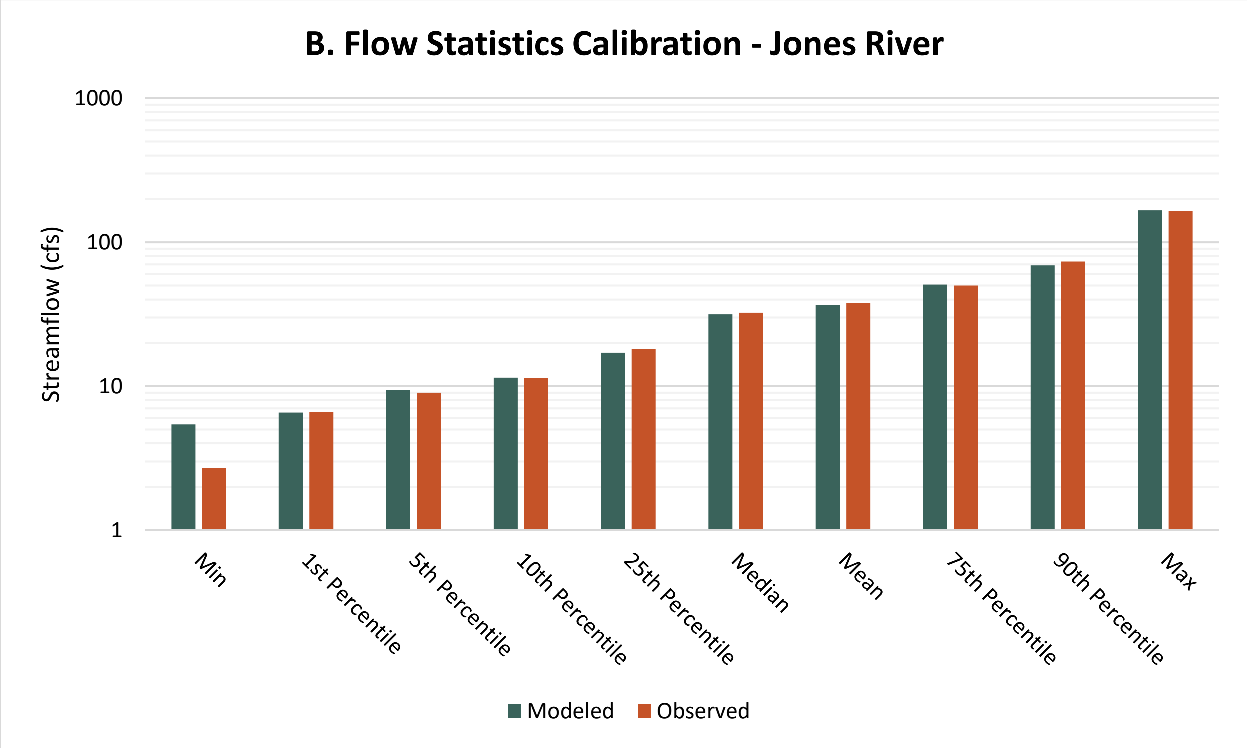
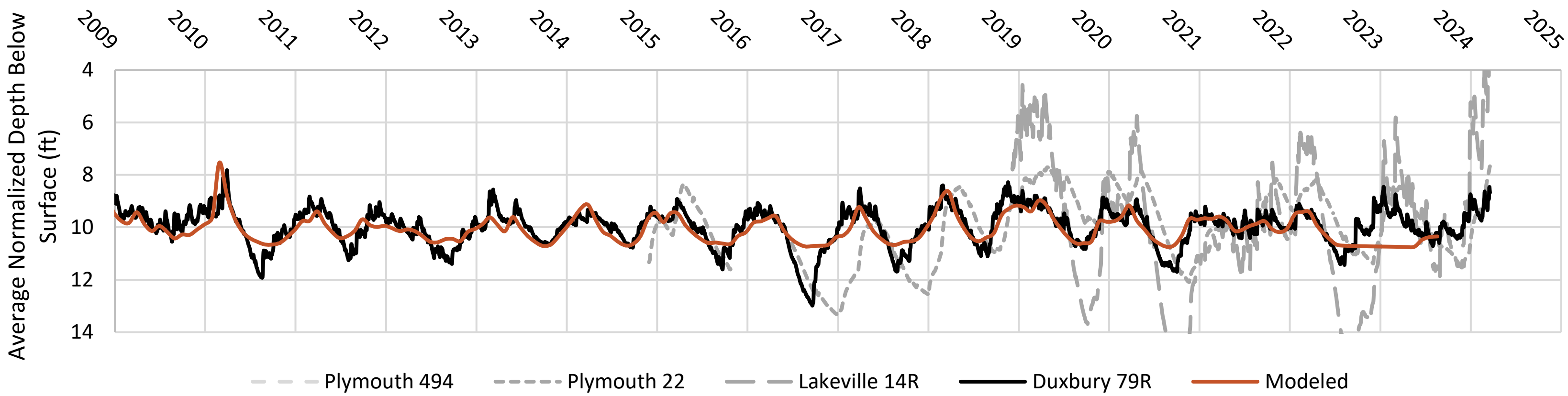


Figure B-6: Calibrated Water Balance Model Using Historic Precipitation and Temperature to Reproduce Historical Flow Statistics

A. Calibrated Groundwater Levels - Jones River



B Calibrated Groundwater Levels - Taunton River

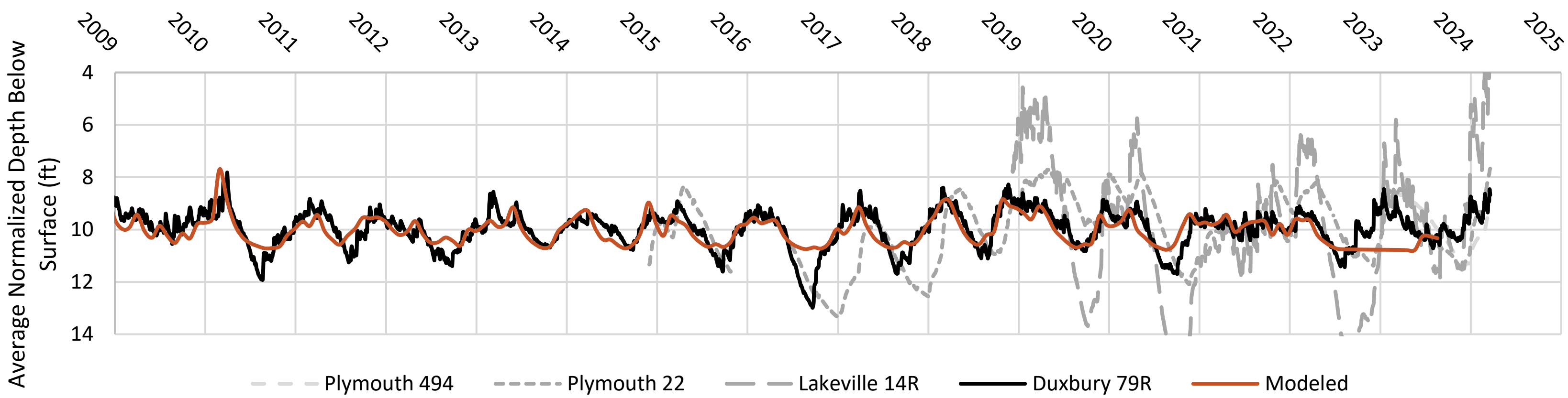


Figure B-7: Calibrated Water Balance Model Using Historic Precipitation and Temperature to Reproduce Historical Groundwater Patterns. Values normalized to a single theoretical ground elevation for comparative purposes

B.4 Future Climate Projections

The purpose of this analysis is to examine the streamflow and groundwater response patterns of the two watersheds to potential future climate trends. To achieve this, we utilized future temperature and precipitation timeseries produced by General Circulation Models (GCMs). In this analysis, GCM output includes both Coupled Model Intercomparison Project (CMIP) 5 and CMIP6 data sets are used to draw conclusions about possible future trends in the Taunton and Jones River Basins.

Localized Constructed Analogs (LOCA), a statistical downscaling technique to interpret global data at the regional level, were obtained at 1/16^{o} intervals. CMIP5 and CMIP6 data, both downscaled to the region using the LOCA method, were obtained from:

- https://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html.
- https://loca.ucsd.edu/loca-version-2-for-north-america-ca-jan-2023

These GCMs use different emissions scenarios to capture future plausible scenarios, referred to as representative concentration pathways (RCPs) for CMIP5 or Shared Socioeconomic Pathways (SSPs) for CMIP6. This analysis used the most extreme emissions scenario, RCP8.5 for CMIP5 and SSP5-8.5 for CMIP6. All 32 CMIP5-RCP8.5 models were used in this analysis, each considered equally plausible. All 11 CMIP6-SSP370 models available at the time of this study were used. However, as the following figures will demonstrate, the hindcasting of the CMIP5 and CMIP6 models was so similar, that only the CMIP5 models were used for future projections, as a simplification of the process.

B.4.1 Hindcasting Assessment

First, we needed to verify if the precipitation and temperature timeseries produced by GCMs could accurately reproduce historical streamflow and groundwater patterns. This serves as a test of the GCMs "hindcast" ability before using them to provide input for future projections.

Figure B-8 illustrates the ability of 5 randomly selected CMIP5 GCMs to reproduce historic streamflow and groundwater patterns in the Taunton River using simulation of historical carbon emissions to generate estimates of historical monthly precipitation and temperature. The timing of precipitation is not expected to align month-to-month with historical patterns, but the overall statistical patterns, especially frequencies, should align well. The figure illustrates that when GCM-generated precipitation and temperature patterns are generated for the historical period, the frequency of streamflow and groundwater levels is faithfully reproduced. (Note that all 32 CMIP5 models were tested – the figure shows 5 that represent the range of results without oversaturation of graph lines). The exception, as expected, is that very low levels of groundwater are not reproduced, due to the stated limitations in the *abcd* hydrologic model.

Figure B-9 illustrates the same things, with the same conclusions, for CMIP6 models in the Taunton River Watershed.

Because the hindcast performance of the CMIP5 and CMIP6 models for the Taunton River were so similar, only the CMIP5 models were used to demonstrate faithful hindcasting in the Jones River. **Figure B-10** illustrates the results. Here, we see that there is a general upward bias of hindcast low-flows, and corresponding downward bias of hindcast high flows, though hindcast groundwater results are generally well distributed above and below observed results and results modeled with actual historical precipitation and temperature (with the exception, again, of very low groundwater levels, as discussed above). We will keep this bias in mind when evaluating future trends in the Jones River Watershed.

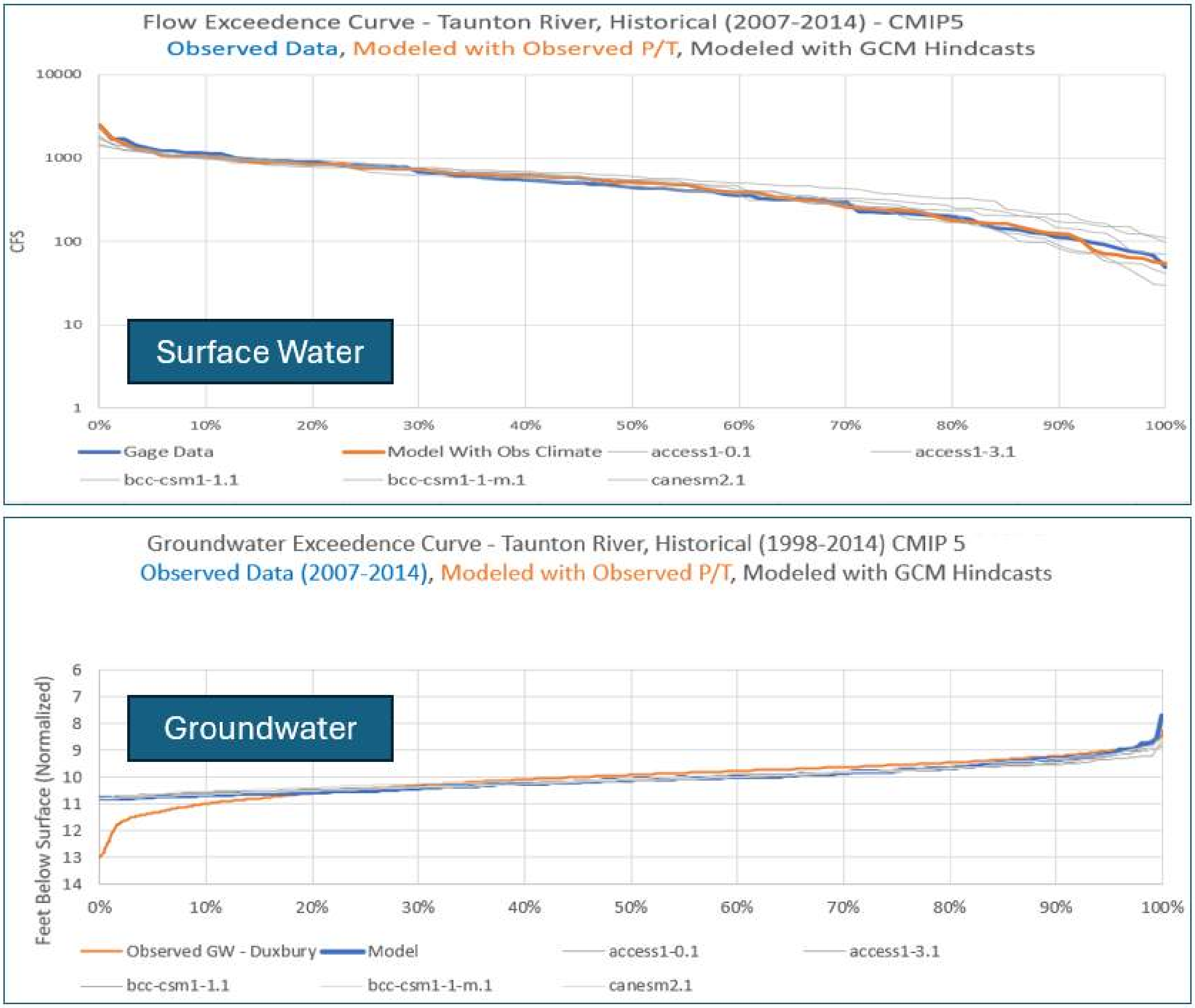


Figure B-8: Representative Historical Hindcast of Global Circulation Models in Taunton River (CMIP5)

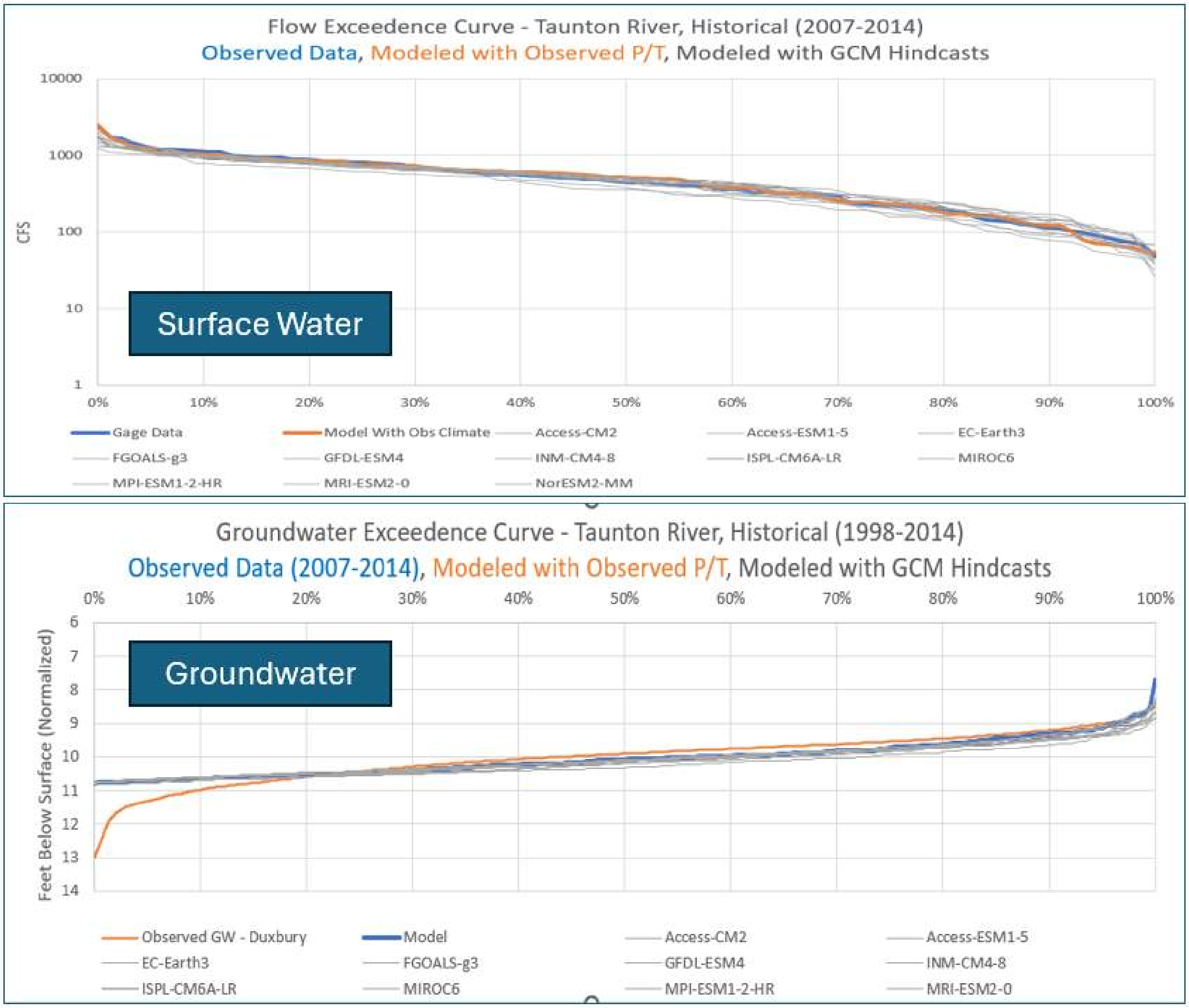


Figure B-9: Representative Historical Hindcast of Global Circulation Models in Taunton River (CMIP6)

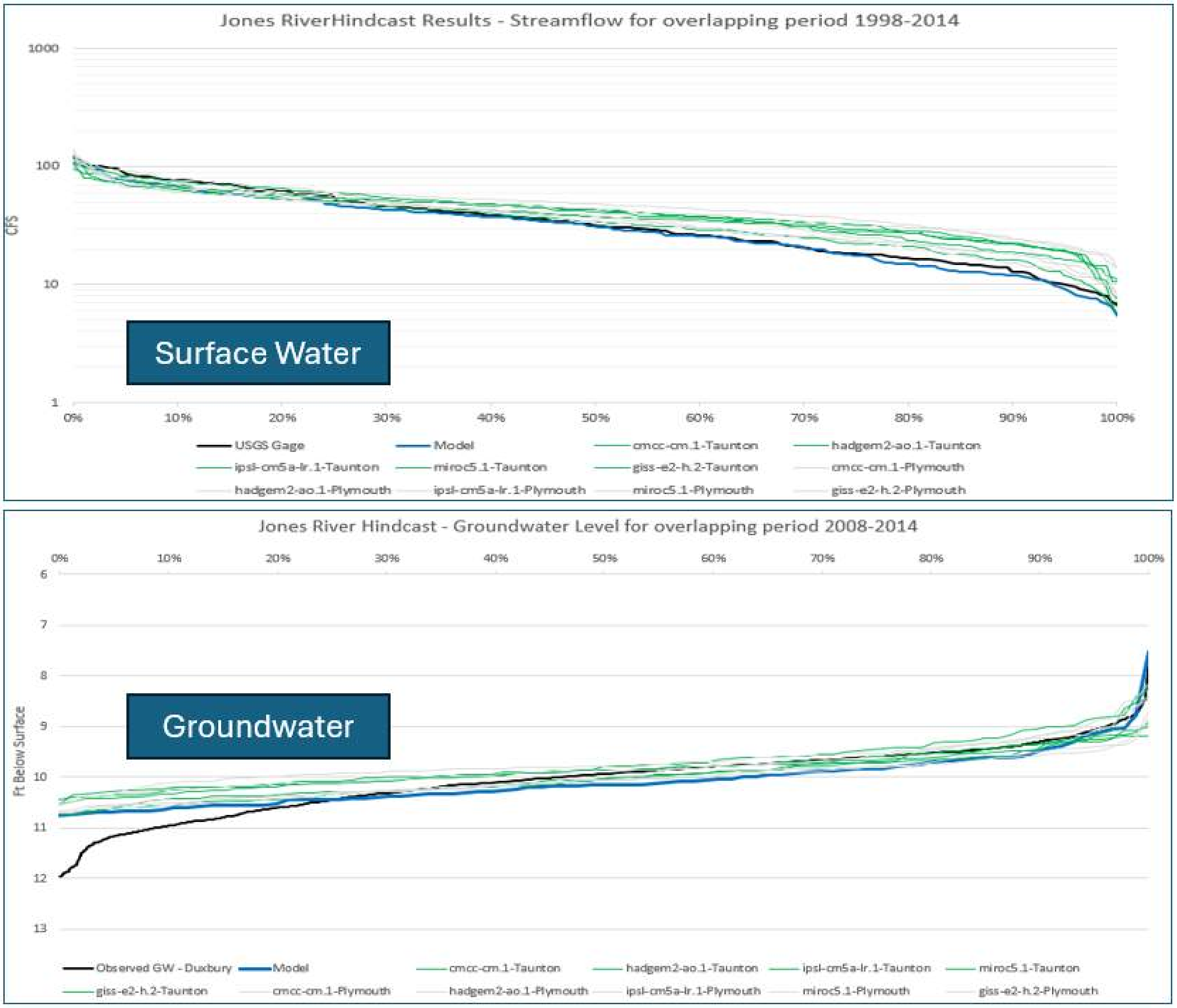


Figure B-10: Representative Historical Hindcast of Global Circulation Models in Jones River (CMIP5)
*Two different rain gages were used, Taunton and Plymouth. The model was calibrated to the Taunton gage – there is little sensitivity.
**The five CMIP5 models selected for this validation were selected because they represented the broadest range of conditions in the Taunton River Watershed, where all of the models were ultimately tested.

B.4.2 Future Assessment

Once the GCMs were validated against both observed data and simulated data using historical values of precipitation and air temperature, their future projections of monthly precipitation and temperature were applied to the calibrated *abcd* models to explore future trends in river flows and groundwater. Again, only CMIP5 models were used in this analysis for simplicity, and since hindcasting suggested such similar performance between the two model sets. **Figure B-11** and **B-12** suggest that future river flows in the Taunton and Jones rivers are likely to be higher during traditionally low-flow periods. All 32 models agree on this, with only several models suggesting slightly lower monthly flows for flows with 98% exceedance probability or higher (up to the 2nd percentile of monthly flows). The hindcast results are included in the Jones River results to help visualize that even with the observed upward bias in the hindcast, future projections tend to be higher in the low-flow regimes. Note that all 32 models are included in the Taunton River projections, and the 5 green traces are associated with the models that cover the full spectrum of river flow projections and are carried into the Jones River output for reduced clutter and improved clarity.

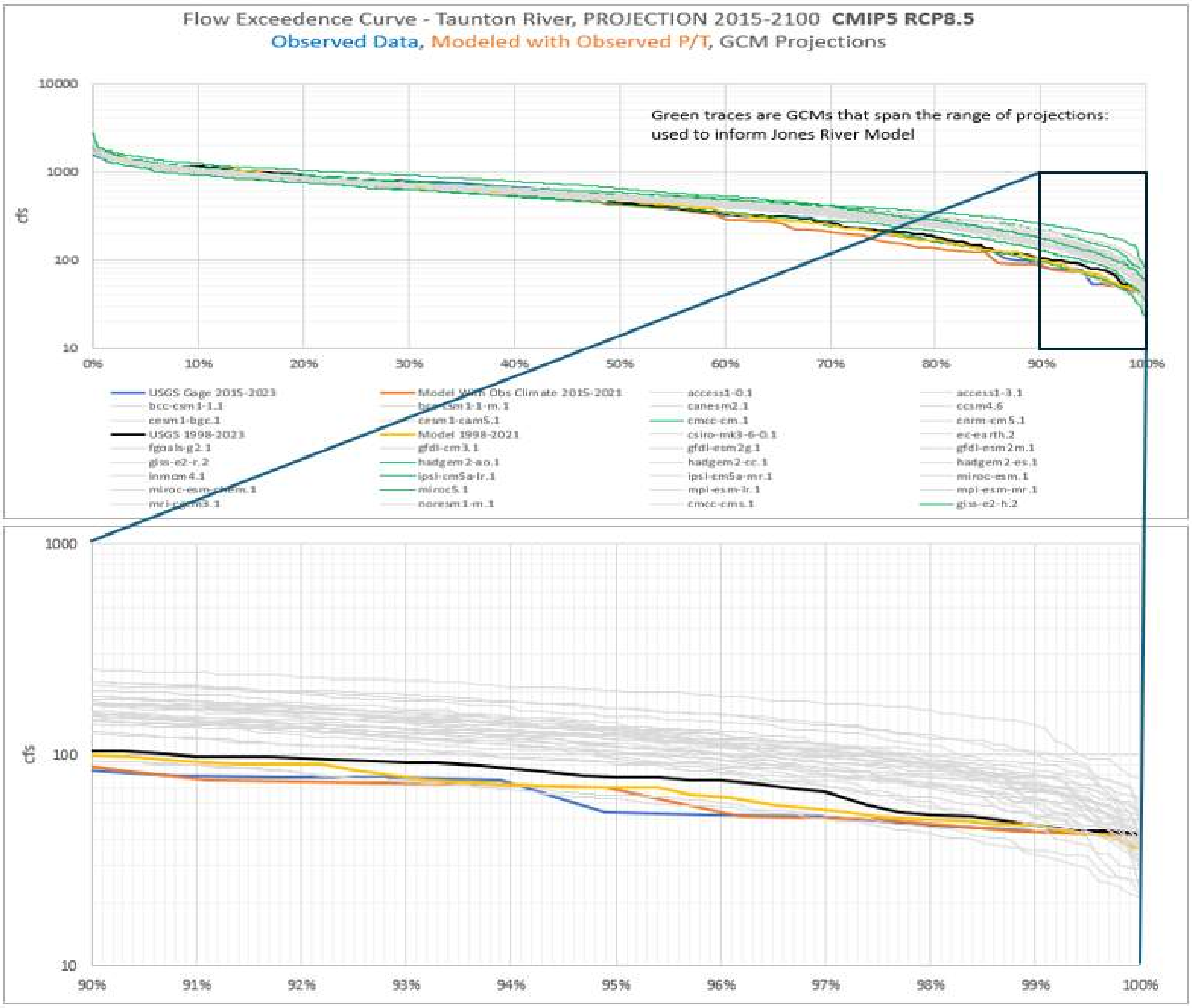


Figure B-11: Projections of Future Streamflow Frequencies – Taunton River (CMIP5, RCP8.5)

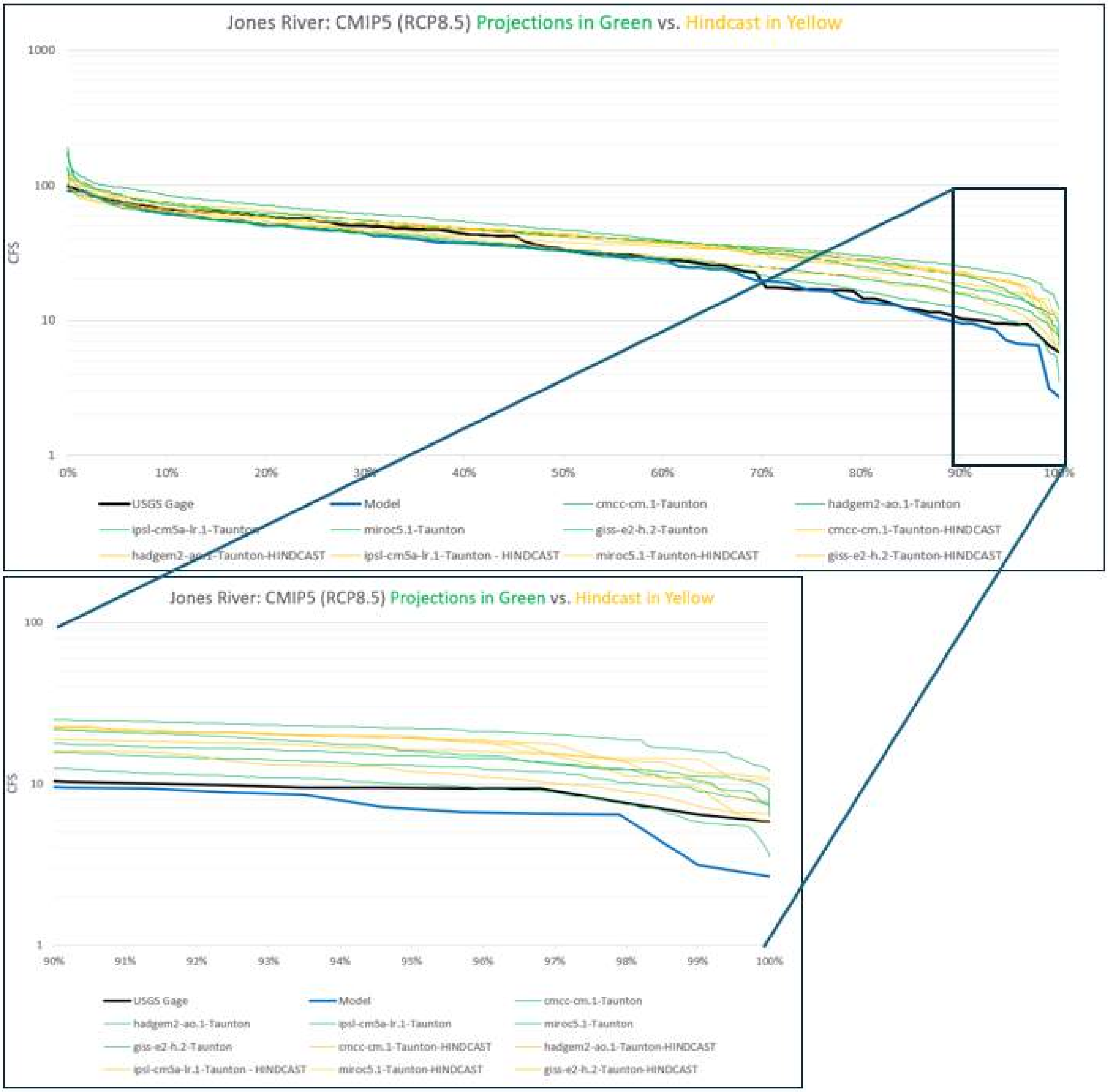


Figure B-12: Projections of Future Streamflow Frequencies – Jones River (CMIP5, RCP8.5)
**The five CMIP5 models selected for this validation were selected because they represented the broadest range of conditions in the Taunton River Watershed, where all of the models were ultimately tested.

Unlike the clear projections of increasing flows in the low-flow regimes of both the Taunton and Jones Rivers in the future, groundwater levels and fluctuations can be expected to remain fairly constant. **Figures B-13** and **B-14** illustrate that the frequencies of various groundwater levels are fairly insensitive to the range of future projections.

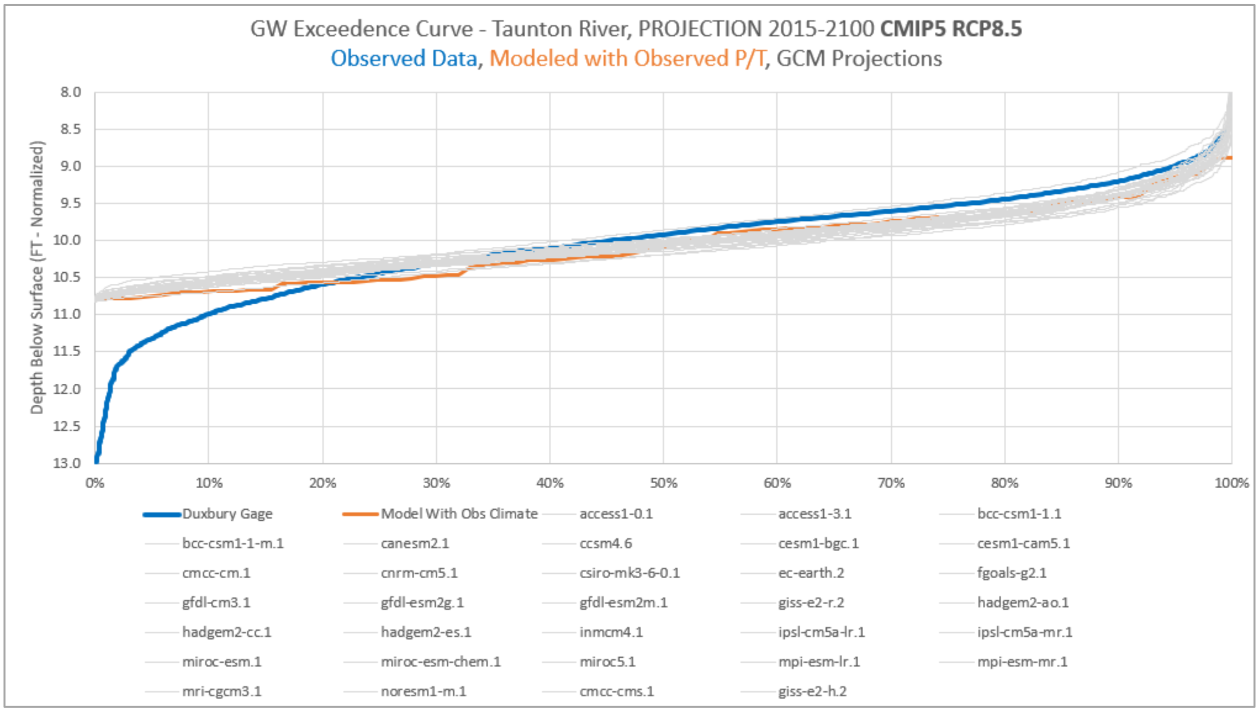


Figure B-13: Projections of Future Groundwater Level Frequencies – Taunton River (CMIP5, RCP8.5)

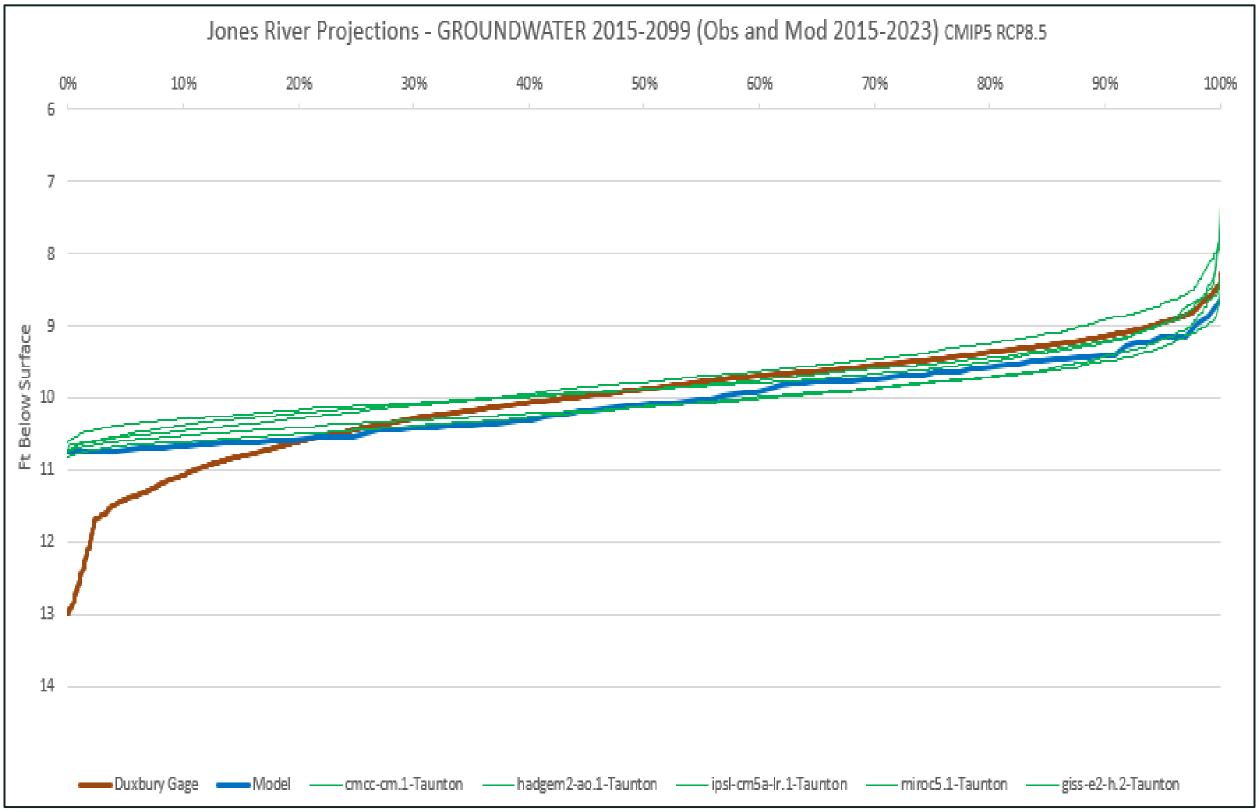


Figure B-14: Projections of Future Groundwater Level Frequencies – Jones River (CMIP5, RCP8.5)

B.5 Discussion

The results of this assessment on future water availability in the Taunton and Jones Rivers suggests two clear findings, but comes with a number of cautions with respect to supply planning:

Findings:

- Seasonal Low-Flow levels in the Taunton and Jones River are likely to be higher, on average, as the 21st century progresses. Almost every model agrees on this trend.
- Groundwater fluctuations in both watersheds are likely to be similar to historic patterns.

Caveats:

- While the projected increases in low flow are encouraging, the results represent long-term average conditions, and are not expected to occur every year. A supplemental analysis in **Section B-6** will help us understand the potential future frequency and duration of dry periods.
- These results are representative of watershed-wide phenomena, which are necessarily generalized. Localized future changes, particularly in small tributaries and groundwater levels near water supply pumps, may not exhibit the same patterns as the watersheds as a whole.
- Supply planning must necessarily consider uncertainties and include contingency plans for future conditions that may not match expectations. Assessing future conditions is subject to many uncertainties, such as actual emission patterns, causal relationships between atmospheric and oceanic patterns, etc. While these results may be used to help prioritize decisions and investments, they cannot be an assurance of future supply increases, stability, or reliability.
- Changes in precipitation and temperature trends are not the only way that climate change will manifest in the region and affect its natural resources. Sea level rise may affect inland salinity in rivers like the Taunton, and this could have implications to salinity at the intake of the Dighton desalination plant, brine disposal from the plant, and aquatic habitat in regional rivers.

A supplemental analysis of future drought potential is included in this study as well, in **Section B-6**. With the results presented there, we will better understand the likelihood of the frequency, duration, and severity of future rainfall deficits, and this will help us interpret the findings above with more clarity and confidence.

B.6 Future Drought Duration and Severity Projections

The frequency of droughts in the Northeast has decreased between 1901 and 2015, although not as much as would have been expected given the region's increase in average precipitation (Krakauer et al, 2019). While drought frequency has decreased, heat stress has increased. CDM Smith's Research and Development has developed a patent pending statistical analysis to assess future likelihood of meteorological droughts. As part of the OCPC Regional Water Plan, CDM Smith has dedicated research and development budget to applying this analysis to the OCPC Region. This section presents the results of that analysis. While this analysis projects a wetter future, it should be noted that there are limitations to this analysis. There is much uncertainty with projecting future droughts. As future temperatures increase, water carrying capacity of the atmosphere increases, changing rainfall patterns and intensifying rainfall events. This may mean that while there is a wetter future for this region, the cycle between flooding and droughts become more pronounced.

This analysis uses data from the NOAA weather data gauge in Plymouth (USC00198367), along with hindcast and forecast from CMIP5 general circulation models (GCMs) for RCP8.5 to model changes to meteorological drought. Meteorological drought occurs when a region is dominated by reduced precipitation and there is a rainfall deficit. This analysis considers future drought frequency, duration, and severity of meteorological droughts, as defined:

- **Severity** is defined as how intense a drought is, measured in inched of precipitation deficit compared to historically observed conditions.
- **Duration** is defined as how long a meteorological drought lasts for.

This analysis used different time horizons for this analysis, listed in **Table B-3**. For these time horizons, statistics were developed for different duration meteorological droughts using stochastic timeseries. Results of future changes to meteorological droughts for different durations (3 months, 6 months, 12 months, 24 months) are shown in **Figure B-15**. This shows that the severity of meteorological droughts is anticipated to approximately halve for all of the different durations. This matches results shown in **Section B.4**. While there is much uncertainty with GCMs, these results indicate that the risk from drought to water resources in the region is anticipated to decrease by the end of the planning horizon.

Table B-3: Time Horizons Used in Drought Analysis

Time Horizon	Years
Historic	1950-1999
Future	2050-2099

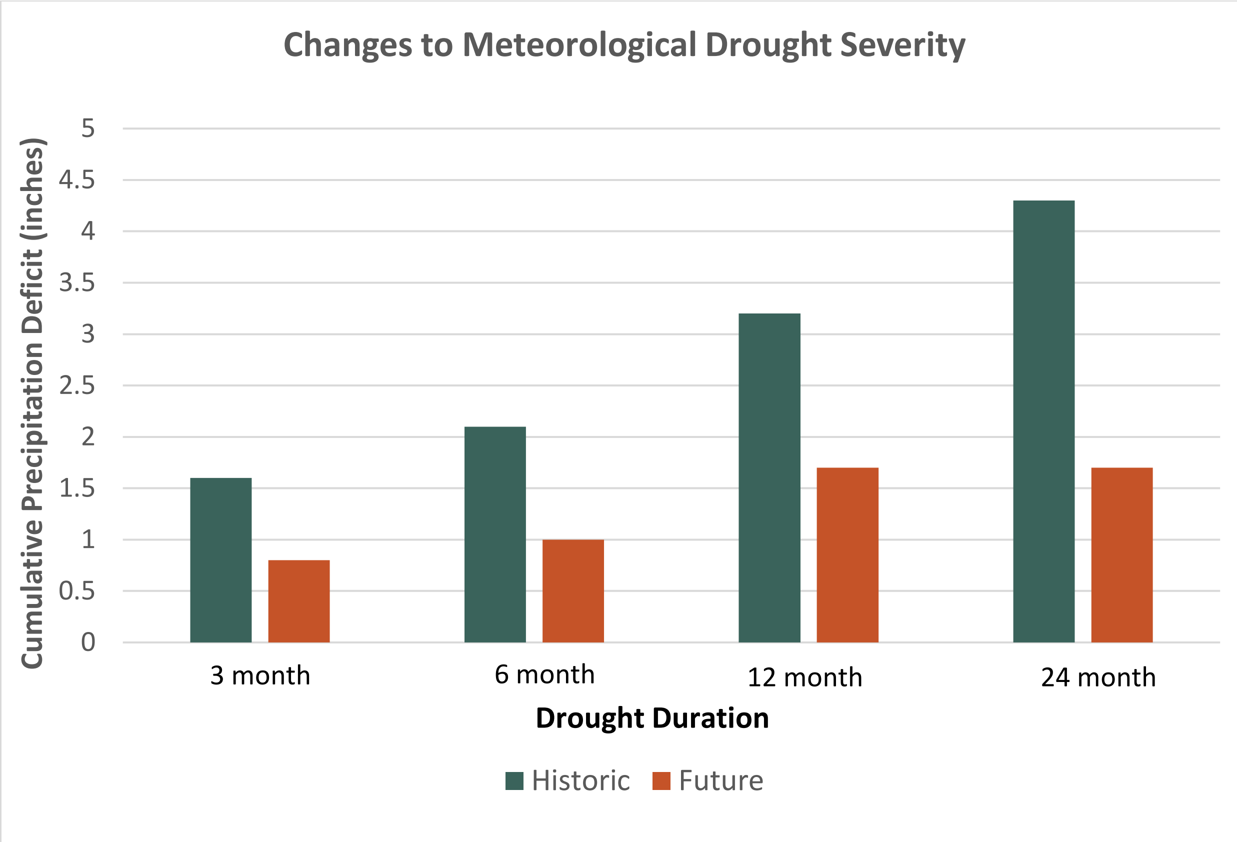


Figure B-15: Changes to Meteorological Drought Severity in the OCPC region for Different Drought Durations.

B.7 References

Thomas Jr., Harold A. 1981. *Improved methods for national water assessment, water resources contract WR15249270*. Prepared for the United States Geological Survey. https://doi.org/10.3133/70046351

Krakauer, N.Y., T. Lakhankar, and D. Hudson, 2019: Trends in drought over the northeast United States. Water, 11 (9), 1834. https://doi.org/10.3390/w11091834

Appendix C Demand Projections Memorandum

Memorandum

To: *Old Colony Planning Council Regional Water Plan Steering Committee*

From: *Kirk Westphal, PE*
Brian Shepard, AICP
Amara Regehr, EIT

Date: *July 3, 2024*

Subject: *Old Colony Planning Council Regional Water Plan – Water Demand Projections*

Executive Summary

Old Colony Planning Council (OCPC) is developing a stakeholder-driven Regional Water Plan to identify the steps needed to achieve a sustainable, resilient water supply across the planning horizon for the OCPC planning area. A key step in assessing water supply reliability for the 17 OCPC member communities is projecting water demands in future years. This memo summarizes the data, methods, and results for the water demand projection analysis completed by CDM Smith to support the OCPC Regional Water Plan.

The methodology used for the demand projections, outlined in **Figure ES-1**, begins with collection of historical water use, demographic, economic, and weather data. Statistical data analysis was performed to determine the best mathematical function to describe historic demand. From this analysis, the key factors which influence demand are identified and their statistical relationships with water demand are established. Projected values for the demographic, economic, and weather variables are applied to the mathematical function, which results in projected water demand in future years for the OCPC planning area.

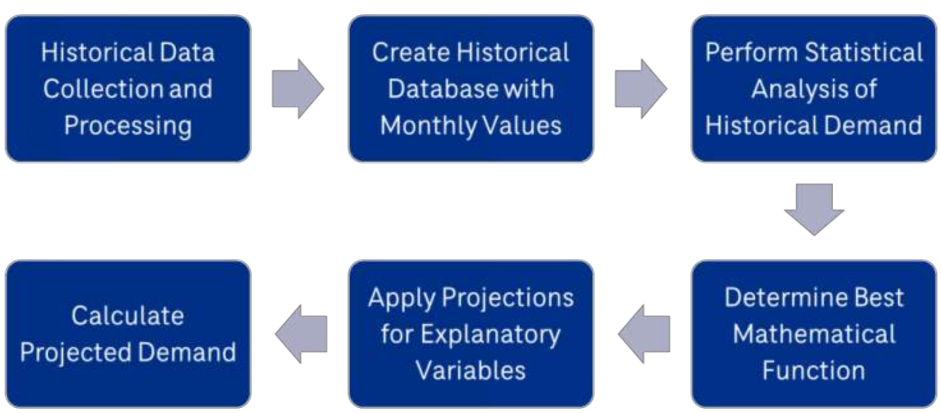


Figure ES-1. Overview of Demand Projection Process

Historical water use for the OCPC planning area, as shown in **Figure ES-2**, has ranged from a high of 11,674 million gallons (MG) in 2016 to a low of 10,599 MG in 2012. The unit use rate, expressed as gallons per capita daily (GPCD), has steadily decreased from a high of 86.5 GPCD in 2015 to 76 GPCD in 2021 for the planning area. GPCD values represent total per capita usage, which includes residential and nonresidential consumption plus Unaccounted for Water (UAW). Reductions in per capita water use have resulted in total demands being relatively consistent over the past several years despite increases in population served.

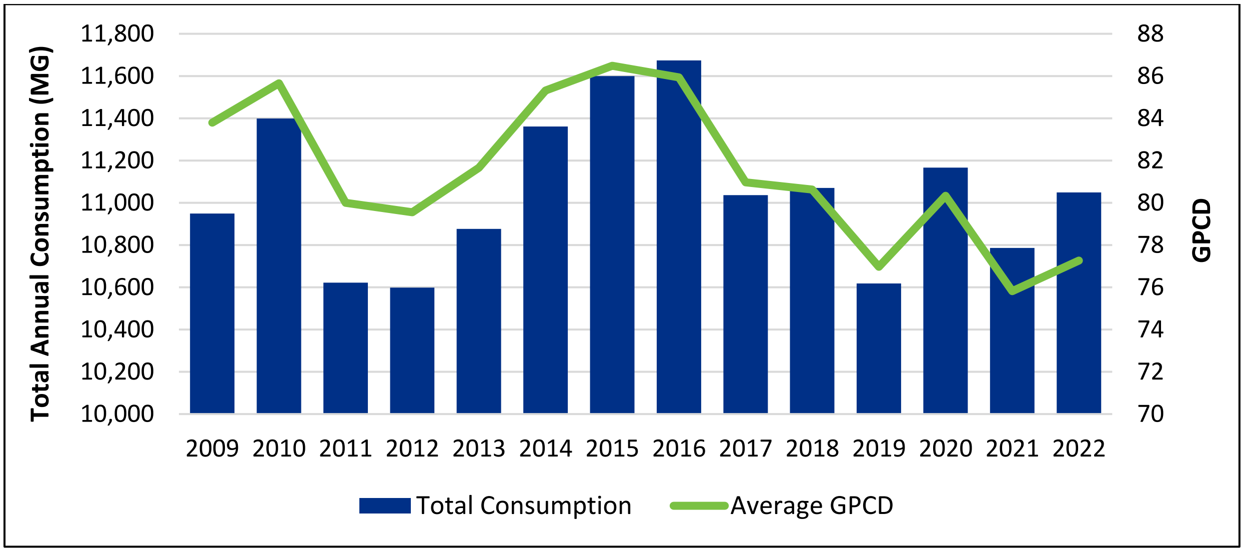


Figure ES-2. Historical Annual Consumption and Per Capita Use for OCPC Planning Area, 2009 to 2022

Statistical analysis of historical demands was conducted using an econometric function - a specialized form of regression analysis that incorporates economic variables. Binary (or "on/off") variables can be incorporated for qualitative data. The variables which potentially explain water demand in the OCPC planning area were analyzed to identify the combination of variables with the highest correlation to **per capita water demand**, as shown in **Table ES-1**. The statistical analysis resulted in a mathematical function indicating that 87.4 percent of demand in the OCPC planning area can be explained by the statistically significant variables.

Table ES-1. Variables Tested for Statistical Significance

Statistically Significant Variables (Included in Model)	Statistically Insignificant Variables (Not Included in Model)
• Average maximum temperature (TMAX)	• Average minimum temperature (TMIN)
• Number of days in a month above 85°F	• TMAX in prior month(s)
• Total monthly precipitation (in inches)	• Number of days in a month above 90°F and 80°F
• Total monthly precipitation in prior month	• Number of days in a month without precipitation
• Indoor plumbing efficiency index	• Unemployment rate
• Summer months (June, July, August) (binary)	• Unemployment rate greater than 7 percent (binary)
	• Unemployment rate greater than 8 percent (binary)
	• Median household income
	• COVID-19 (binary)*

*March 2020 through May 2021

Coefficients for each variable from the statistical analysis can be used to determine the percent change in demand from a change in the value of each variable, as shown in **Figure ES-3**. For example, a 10 percent increase in average max temperature equates to a 2.12 percent increase in demand, while a 10 percent decrease in precipitation results in a 0.99 percent increase in demand. Change in the efficiency variable has the largest impact on demands of all the variables in the model and is a major factor in projected demands for the OCPC planning area.

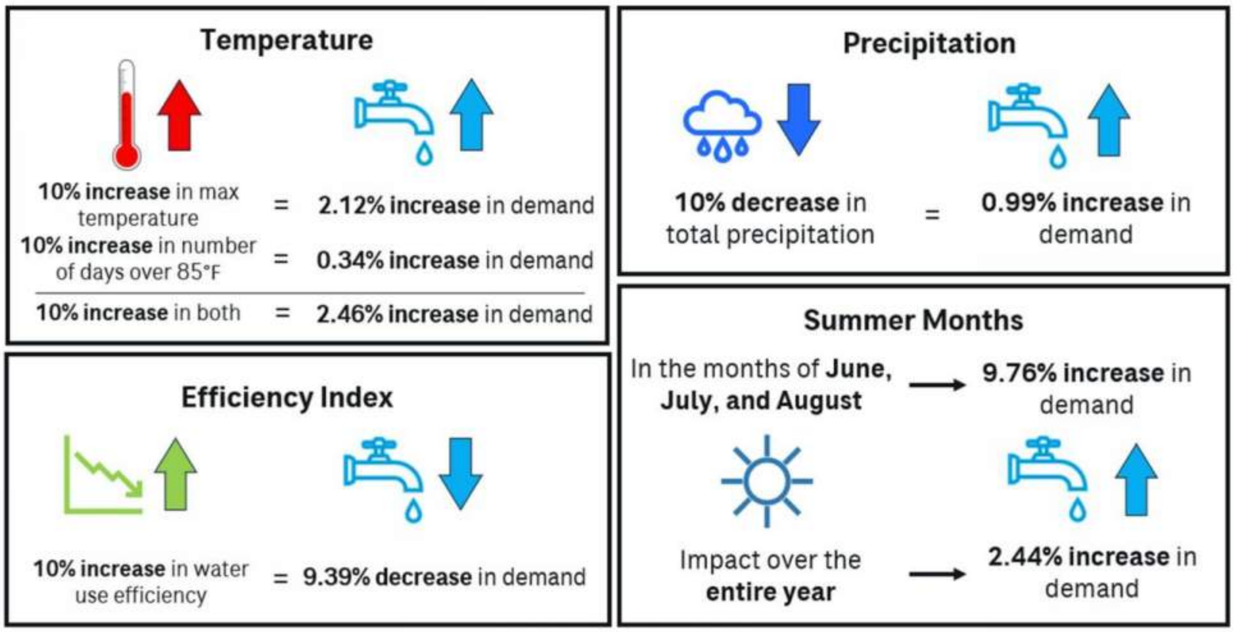


Figure ES-3. Impact of Variables on Water Demand in OCPC Planning Area

Projected values for the independent variables were input into the econometric function to calculate projected GPCD across the planning horizon. The projected GPCD values were multiplied by projected population to calculate projected water consumption for the OCPC planning area. Historical average volume of UAW was added to the projected consumption to determine projected total demand for the OCPC planning area. Demands are projected to decrease across the planning horizon, as shown in **Figure ES-3**, due to continued improvements in water use efficiency and minimal population growth. This demand projection, referred to as the **baseline projection**, utilizes historical averages for weather and projected population from UMass Donahue Institute.

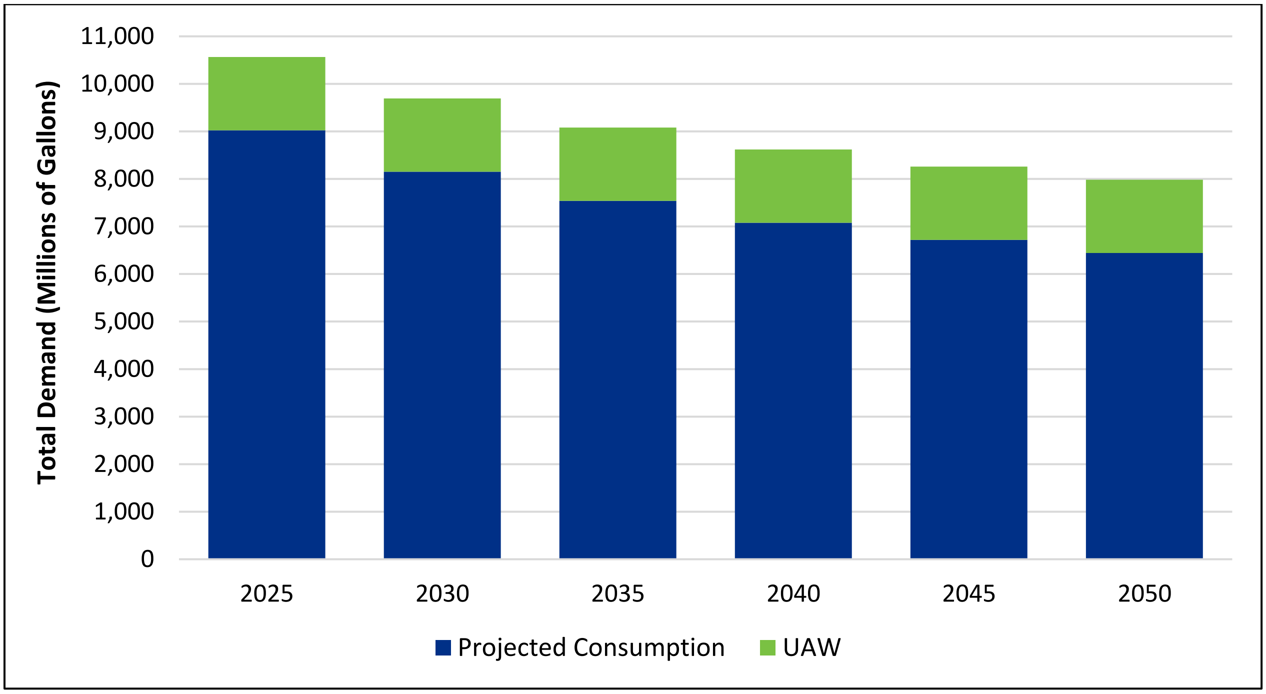


Figure ES-3. Projected Consumption and UAW for OCPC Planning Area, 2025 to 2050

Per capita water demand is projected to decrease across the planning horizon due to improved efficiency of plumbing fixtures and appliances, a process called **passive conservation**. Recently enacted legislation in Massachusetts[1] mandates minimum efficiency standards more stringent than the existing Federal standards for various plumbing fixtures. Additional standards set by the U.S. Department of Energy for residential clothes washers will also reduce water demand over the planning horizon. Technological advances from manufacturers that reduce water consumption even more than the state and Federal standards will continue to reduce per capita water demand as older, less efficient fixtures and appliances are phased out over time.

Alternate projections were developed from the baseline projection to account for various future scenarios. These scenarios evaluate **uncertainties regarding future conditions** of variables that influence water demands to further guide the water resource planning process. The alternate scenarios developed for this analysis, shown in **Table ES-2**, incorporate different levels of population growth, climate variability, different rates of water use efficiency, changes in UAW over historical average, and private well users switching to a public water system (PWS).

[1] *An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy* signed by Governor Baker on March 26, 2021. Available at: https://malegislature.gov/Laws/SessionLaws/Acts/2021/Chapter8

Table ES-2. Alternate Future Scenario Parameters for OCPC Regional Water Plan

Planning Scenario	Population Growth	Future Climate Variability	Water Use Efficiency (Passive Conservation)	Trend in UAW	Private Wells to Public Supply
Baseline	Expected	Historical Average	Average increase in efficiency (current codes)	Constant	None
Low Stress	Expected	Cool/Wet	Greater than average increase in efficiency (high efficiency)	Decrease	None
Significant Stress	10% greater than expected	Hot/Dry	Less than average increase in efficiency (slower rate of meeting current codes)	Increase	100%
Significant Stress with Mitigation	10% greater than expected	Hot/Dry	Greater than average increase in efficiency (high efficiency)	Decrease	100%

Projected **demands decrease** across the planning horizon under **all future scenarios**, as shown in **Figure ES-4**. The projected decrease in demand is due to efficiency improvements over time (i.e., passive conservation), which has a significant impact on overall water use for the OCPC planning area, **even in scenarios with significant population growth and climate variability**.

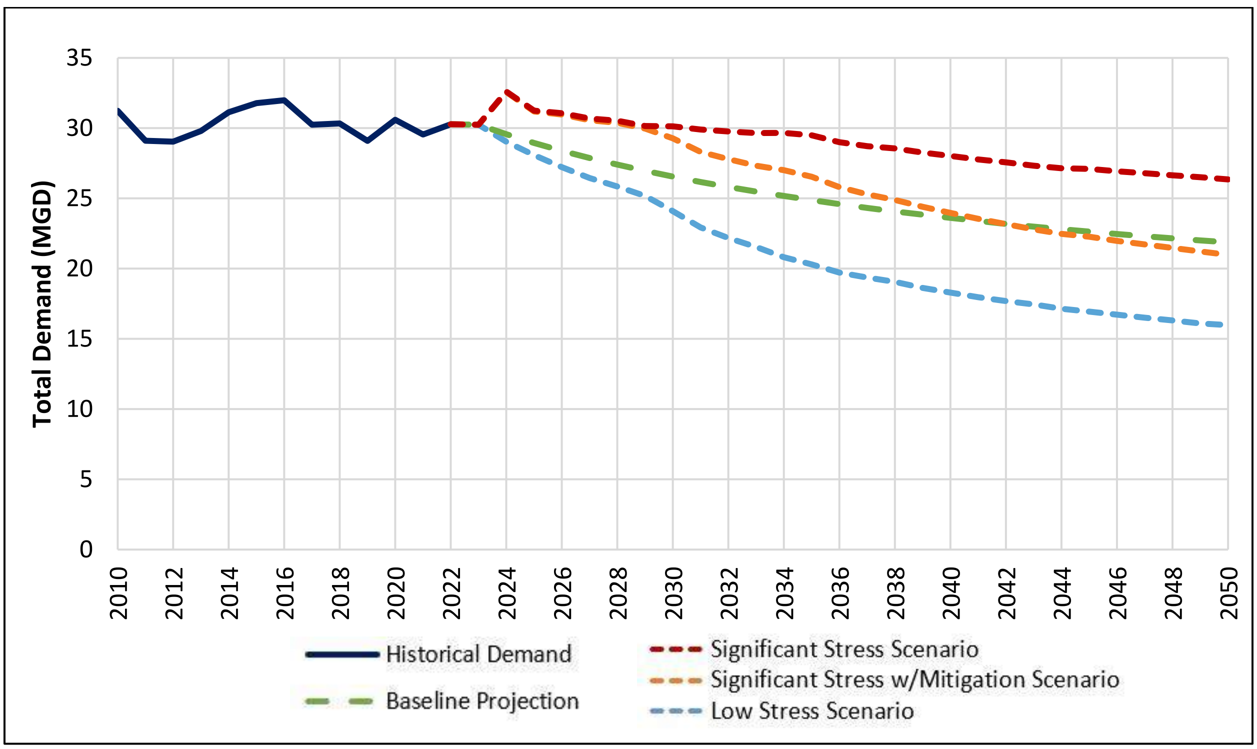


Figure ES-4. Historical and Projected Demand for OCPC Planning Area Under Various Future Scenarios

1.0 Introduction

Old Colony Planning Council (OCPC) is developing a stakeholder-driven Regional Water Plan with support from CDM Smith. This Plan will serve all 17 communities included in the OCPC planning area: Abington, Avon, Bridgewater, Brockton, Duxbury, East Bridgewater, Easton, Halifax, Hanover, Hanson, Kingston, Pembroke, Plymouth, Plympton, Stoughton, West Bridgewater, and Whitman. A key step in assessing water supply reliability for the OCPC member communities is projecting water demands. This memo summarizes the data, methods, and results for the demand projection analysis completed by CDM Smith to support the OCPC Regional Water Plan.

The process followed for the demand projections is summarized in **Figure 1**. First, historical data was collected and processed for use in this analysis and used to create a database of monthly data. This is summarized in **Section 2**. Next, statistical analysis was performed on historical data and the best mathematical function to describe historic demand was determined, the details of which are included in **Section 3**. From this analysis, the key explanatory factors of demand are identified and their statistical relationships with water demand are established, which is then used to project future demands based on changes in the explanatory factors over time. The demand projection results for the OCPC Planning Area are presented in **Section 4**. Results are also shown by member community, which is included in **Section 5**.

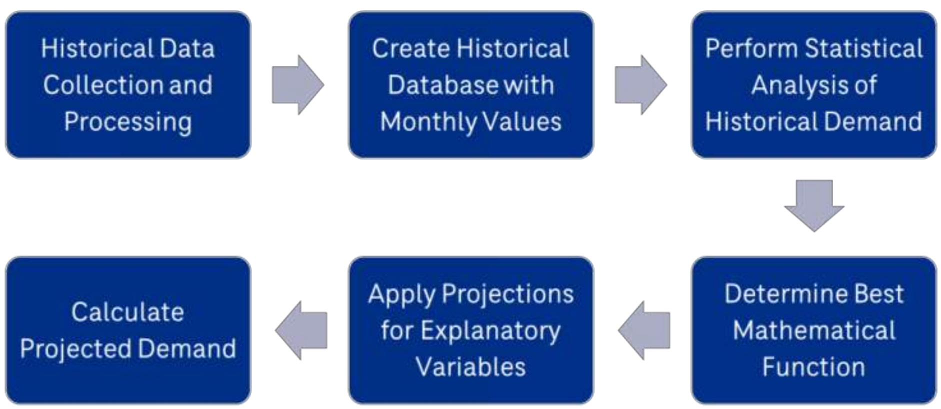


Figure 1. Overview of Demand Projection Process

This document summarizes the analysis conducted to project water demands out to 2050 for the OCPC planning area. Projected demands were also disaggregated by each member community to allow for supply planning by watershed/basin. Demands are representative of a baseline projection which uses historical average climate, historical average unaccounted for water (UAW), and recent trends of water use efficiency improvements over time.

Alternate projections were developed from the baseline projection to account for various future scenarios, which is discussed in **Section 6**. Uncertainties regarding future conditions of variables that influence water demands can be evaluated by different scenarios and estimated ranges of future demands under different conditions can be derived to further guide the water resource planning process.

2.0 Data Processing Methodology

A database was created with monthly values for historical water use and multiple potential explanatory variables of water use. Changes in the value of an explanatory variable (also known as an independent or predictor variable) result in changes to the value of the dependent variable, which in this analysis is volume of water consumed (i.e., cause and effect). This section discusses the data sources and preprocessing required for the statistical analysis, while **Section 3** presents how this data is used in the demand projections. Historical population by community is used in conjunction with historical water use data to calculate historical per capita use by community and for the region. The potential explanatory variables compiled for this analysis include:

- Weather Data
  - Average maximum temperature (TMAX)
  - Average minimum temperature (TMIN)
  - Number of days in a month above 90 °F, 85 °F, and 80 °F
  - Number of days in a month without precipitation
  - Total monthly precipitation (in inches)
- Economic Data
  - Unemployment rate
  - Median household income
- Passive Conservation
  - Indoor plumbing efficiency

Before details on the explanatory variables are provided, discussion of the historical utility data is presented.

2.1 Water Use Data

Historical water use from 2009 to 2022 was analyzed by community based on data provided in Annual Statistical Reports (ASRs) to Massachusetts Department of Environmental Protection (MassDEP). Monthly water use data was used for the statistical analysis to capture seasonal patterns in water use. Historical monthly data was only available for total system water use by community, so separate analyses of residential and nonresidential demands were not able to be performed for this study.

Annual historical water use for the OCPC planning area has ranged from a high of 11,674 million gallons (MG) in 2016 to a low of 10,599 MG in 2012, as shown in **Figure 2**. The unit use rate, expressed as gallons per capita daily (GPCD), has steadily decreased from a high of 86.5 GPCD in 2015 to 76 GPCD in 2021 for the planning area. GPCD values represent total per capita usage, which includes residential and nonresidential consumption plus Unaccounted for Water (UAW). Reductions in annual average GPCD have resulted in total demands being relatively consistent over the past several years despite increases in population served.

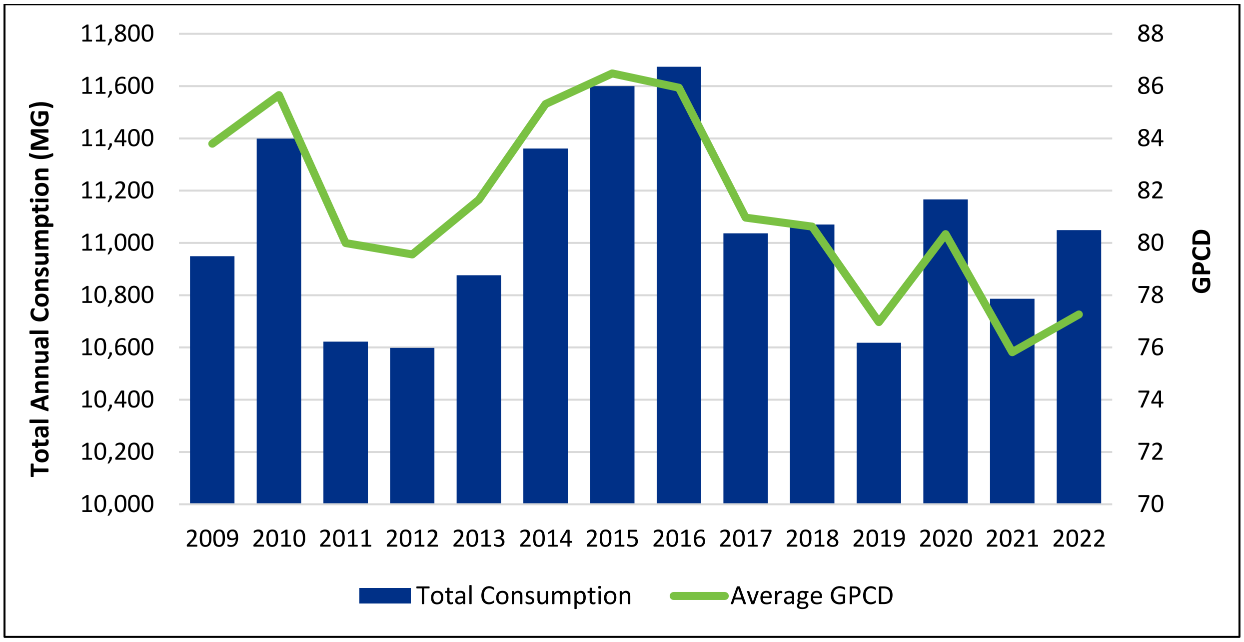


Figure 2. Historical Annual Consumption and Per Capita Use for OCPC Planning Area, 2009 to 2022
Note: Data was adjusted with estimated use for Stoughton in 2013 and Bridgewater in 2022

The data provided by the communities for UAW was not viewed as generally reliable, based on a comparison of revised UAW data from Massachusetts Department of Environmental Protection (MassDEP)[2]. Therefore, the period of historical data included in the statistical analysis was reduced to 2016 through 2022. Historical water consumption data was adjusted to subtract out the volume of UAW based on data provided by MassDEP before statistical analysis of consumptive demands.

2.2 Population Served

Historical population served utilizes data from 2010-2022, combined from ASR data and U.S. Census Bureau's American Community Survey (ACS). Data before this period was determined to be unreliable for this study.

Historical population served for the OCPC planning area, shown in **Table 1**, was relatively unchanged from 2010 through 2014, likely due to lingering impacts of the Great Recession (which officially lasted from December 2007 to June 2009[3]), but then grew at a steady rate between 2015 and 2020. Population served increased notably in 2021, likely due to population shifts resulting from the COVID-19 pandemic.

[2] Available at: https://www.mass.gov/doc/rgpcd-and-uaw-spreadsheet-0/download
[3] https://www.federalreservehistory.org/essays/great-recession-and-its-aftermath

Table 1. Historical Population Served for OCPC Planning Area, 2010 to 2022

Year	Population Served
2010	364,607
2011	363,796
2012	363,991
2013	364,929
2014	364,848
2015	367,470
2016	371,144
2017	373,448
2018	376,185
2019	377,943
2020	379,781
2021	389,772
2022	391,810

2.3 Weather Data

Historical weather data was acquired for three weather stations in the OCPC planning area. The weather stations are listed in **Table 2**. Daily data for maximum temperature, minimum temperature, and total precipitation was aggregated by month for each station from 2016 to 2022. Additional weather parameters were derived from the daily data such as the number of days in a month above 85 degrees Fahrenheit (°F) and number of days in a month without precipitation.

Table 2. List of Weather Stations (with Station ID) Used in Analysis

Station Location	Station ID
Plymouth	USW00054769
Taunton	USC00198367
Blue Hill	USC00190736

Historical weather data was compiled for each community, then weighted based on the average share of total demand for the OCPC planning area. The weighted values for precipitation and temperature were summed to determine representative values for the entire planning area, as shown in **Table 3**. For example, the Town of Abington accounted for an average of 8.8 percent of total annual demand between 2016 and 2022, so the weather data for Abington accounts for 8.8 percent of the total value for temperature and precipitation for the OCPC planning area in **Table 3**.

Table 3. Weighted Historical Weather Data for OCPC Planning Area, 2016 to 2022

Year	Average Max Temperature (°F)	Total Precipitation (inches)
2016	61.0	38.4
2017	59.8	50.9
2018	59.3	68.2
2019	58.1	56.2
2020	60.6	47.4
2021	60.1	56.8
2022	61.0	44.8
Average	**60.0**	**51.8**

2.4 Economic Data

Data for annual median household income (MHI) was collected from 2016 to 2022 for each community from the U.S. Census Bureau and for monthly unemployment rate from 2016 to 2022 for each community from the Bureau of Labor Statistics. The data was weighted by the population served by each community against the total population of the OCPC planning area to determine representative values for MHI and unemployment rate for the entire OCPC planning area. Sufficient historical data for water rates by community was not available for inclusion in this analysis.

MHI is reported by the Census Bureau in nominal dollars, which is the value of the income in that year, so data was adjusted to real dollars, which is the relative value over time, using the Consumer Price Index (CPI) with 2016 as the base year, as shown in **Table 4**. Adjusting the data to real dollars allows for consistent comparison of MHI across the historical period of interest. MHI in nominal dollars has increased substantially between 2016 and 2022, whereas the MHI in real dollars increased by a significantly lower amount.

Table 4. Median Household Income (Nominal and Real Dollars) for OCPC Planning Area, 2016 to 2022

Year	Median Household Income Nominal Dollars	Consumer Price Index Adjustment Factor	Median Household Income Real Dollars
2016	$77,199	1.000	$77,199
2017	$81,768	1.025	$79,767
2018	$85,331	1.058	$80,592
2019	$88,527	1.079	$82,043
2020	$92,869	1.091	$85,104
2021	$99,063	1.127	$87,916
2022	$106,346	1.207	$88,125

The historical weighted monthly unemployment rate for the OCPC planning area, as shown in **Figure 3**, decreased slightly from January 2016 to March 2020 as economic conditions continued to improve in the wake of the Great Recession (December 2007 to June 2009). Unemployment increased dramatically to almost 19 percent in April 2020 due to the global COVID-19 pandemic.

The unemployment rate dropped in subsequent months but remained above the rate from the previous decade for most of 2020. The unemployment rate averaged 4.1 percent in 2022 as economic conditions recovered from the impacts of the COVID-19 pandemic.

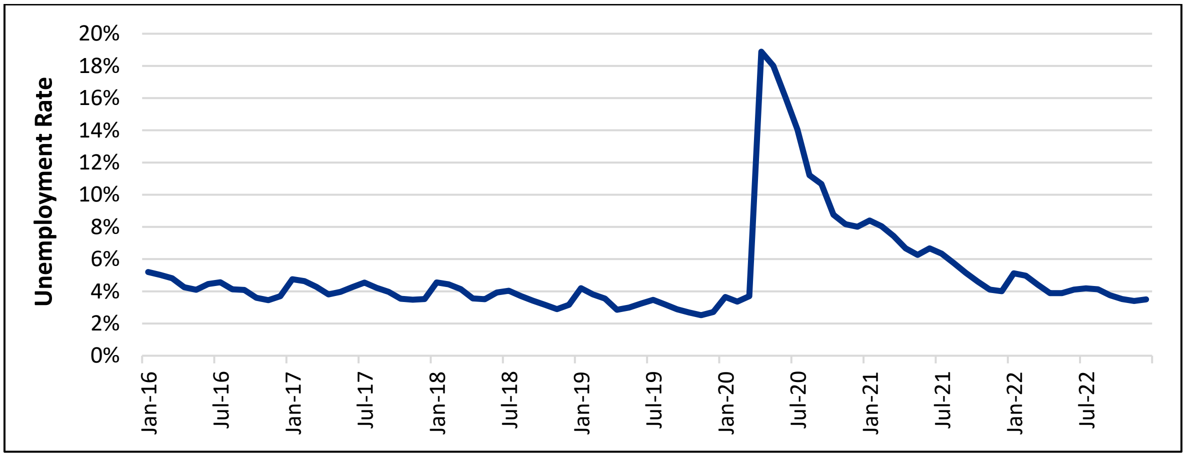


Figure 3. Weighted Historical Unemployment Rate for OCPC Planning Area, 2016 to 2022.

2.5 Passive Conservation

Water use efficiency has improved over the past 30 years in response to changes in legislation, technology, and consumer acceptance of high efficiency plumbing fixtures and appliances. Water savings resulting from changes in end use efficiency over time are considered passive conservation. Federal legislation passed in 1992 and enacted January 1, 1994, established plumbing efficiency standards for all toilets, faucets, and showerheads sold in the United States. The standard for faucet flow rate was further revised in 2005. Massachusetts has implemented state level efficiency standards[4], which took effect January 1, 2023, that further reduce the allowable flow rate of toilets sold to consumers from 1.6 gallons per flush (gpf) to 1.28 gpf. Over the same time, the performance of high efficiency plumbing fixtures has improved and many barriers to customer acceptance have been overcome.

Using information on flow rates by end use and the number of uses per person per day[5], the indoor per capita use rate can be estimated over the historical period. The average lifespan of fixtures and appliances is converted into an annual replacement rate to calculate efficiency over time as old, inefficient fixtures and appliances are replaced with more efficient models. An efficiency index was created, with a base year of 1993 equal to 1.00, where improvements in efficiency over time (i.e., reduced indoor per capita consumption) result in a lower efficiency index value, as shown in **Table 5**. Estimated indoor GPCD has decreased from 90 GPCD in 1993 to 63 GPCD in 2022 based on current plumbing codes and replacement of fixtures/appliances over time (i.e., savings from passive conservation).

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[4] *An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy* signed by Governor Baker on March 26, 2021. Available at: https://malegislature.gov/Laws/SessionLaws/Acts/2021/Chapter8

[5] based on data from the Water Research Foundation *Residential End Uses of Water, Version 2* (2016)

Table 5. Historical Efficiency Index for OCPC Planning Area, 2016 to 2022

Year	Indoor Use (GPCD)	Efficiency Index
2016	66	0.74
2017	65	0.73
2018	65	0.72
2019	64	0.72
2020	64	0.71
2021	64	0.71
2022	63	0.71

3.0 Demand Projection Methodology

The methodology for developing demand projections for the OCPC Regional Water Plan is detailed in this section. An econometric model, based on historical data discussed in **Section 2**, is used for these projections. After validation, this model forms the foundation for generating future projections. Each step is elaborated further in the subsequent subsections.

3.1 Econometric Model

Statistical analysis of historical demands was conducted using an econometric function – a specialized form of regression analysis that incorporates economic variables. This method assumes per unit water use is a function of several explanatory factors (i.e., independent variables). An econometric function also incorporates known causal relationships and time dependency to establish the quantitative impact of variables on demand. An econometric function can capture changes in both the projected values of explanatory factors (e.g., weather, income, water use efficiency, etc.) and forecasted drivers (population, housing, etc.). Binary (or ”on/off”) variables can be incorporated for qualitative data.

The potential explanatory variables were analyzed to identify the combination of variables with the highest correlation to per capita water demand. This analysis uses Adjusted R^2 to measure correlation, which indicates the proportion of the variation in the dependent variable that is predictable from the independent variables. In other words, Adjusted R^2 provides a measure of how well observed outcomes are replicated by the model. The possible values for Adjusted R^2 range from 0 to 1 with 1 being the highest possible value indicating a perfect correlation between the model and observed data.

Numerous combinations of variables were tested to ensure the variables had statistical significance and the correct relationship (direct or inverse) with demand. The variables tested for statistical significance in this analysis are shown in **Table 6**. The combination of variables with the highest correlation to per capita water demand for the OCPC planning area resulted in an Adjusted R^2 value of 0.874 which indicates that 87.4 percent of demand can be explained by the independent variables. All variables have a t-statistic with an absolute value greater than 1.976 and a p-value of less than 0.05 which indicates each variable is statistically significant. Each variable coefficient has the correct sign indicating a direct or inverse relationship.

Table 6. Variables Tested for Statistical Significance

Statistically Significant Variables (Included in Model)	Statistically Insignificant Variables (Not Included in Model)
• Average maximum temperature (TMAX) • Number of days in a month above 85°F • Total monthly precipitation (in inches) • Total monthly precipitation in prior month • Indoor plumbing efficiency index • Summer months (June, July, August) (binary)	• Average minimum temperature (TMIN) • TMAX in prior month(s) • Number of days in a month above 90°F and 80°F • Number of days in a month without precipitation • Unemployment rate • Unemployment rate greater than 7 percent (binary) • Unemployment rate greater than 8 percent (binary) • Median household income • COVID-19 (binary)*

*March 2020 through May 2021

A binary variable was added during the analysis for summer months due to observed seasonal fluctuations in demand that were not already explained by the variables included in the analysis, likely a result of seasonal influx of tourists and changes in water use behavior in the area. Several communities in the OCPC planning area experience seasonal population increases and tourism that are not captured in the traditional population served data. Binary variables are either set to "1" if the given condition is present or "0" if the given condition is not present.

Variables were transformed into natural logarithmic form which results in variable coefficients that represent elasticities of demand (i.e., the change in one variable in response to change in another variable). Changes in the independent variables, as shown in **Table 7**, result in a measurable percent change in the dependent variable (GPCD).

Table 7. Impact of Changes in Independent Variables on Water Demand for OCPC Planning Area

Variable	Change in Variable	Change in Demand
Average max temperature (in °F)	10% increase	2.12%
Number of days above 85°F	10% increase	0.34%
Total monthly precipitation (inches)	10% increase	-0.49%
Total precipitation in prior month (inches)	10% increase	-0.50%
Efficiency index	10% increase	-9.39%
Summer (0/1)	When active	9.76%

3.2 Model Verification

The result of the econometric analysis is a mathematical function that can be used to project future water demands based on the projected values for each variable. Before applying the function to project future demands, the function can also be used to evaluate the accuracy of the analysis by comparing predicted demand from the model to actual historical demands.. As depicted in **Figure 4**, the estimated demand from the function aligns closely with the observed historical values, demonstrating the model's accuracy.

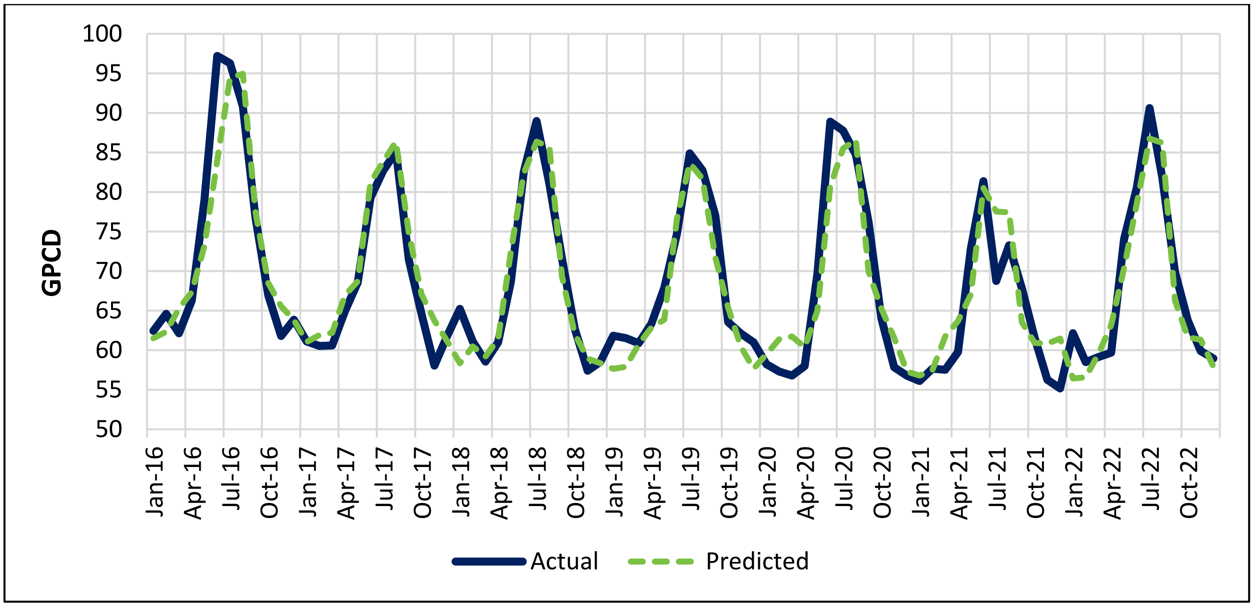


Figure 4. Comparison of Historical Demand to Predicted Demand from Statistical Model

Another method employed for comparing observed demands to the predicted demands from the mathematical model involves analyzing the minimum and maximum monthly demands, as illustrated in **Figure 5.** The results indicate that the statistical function generated for the OCPC planning area is valid for use in projecting future demands. Capital improvements are often tied to peak demands, so it is important to validate the model's ability to reproduce maximum demand values.

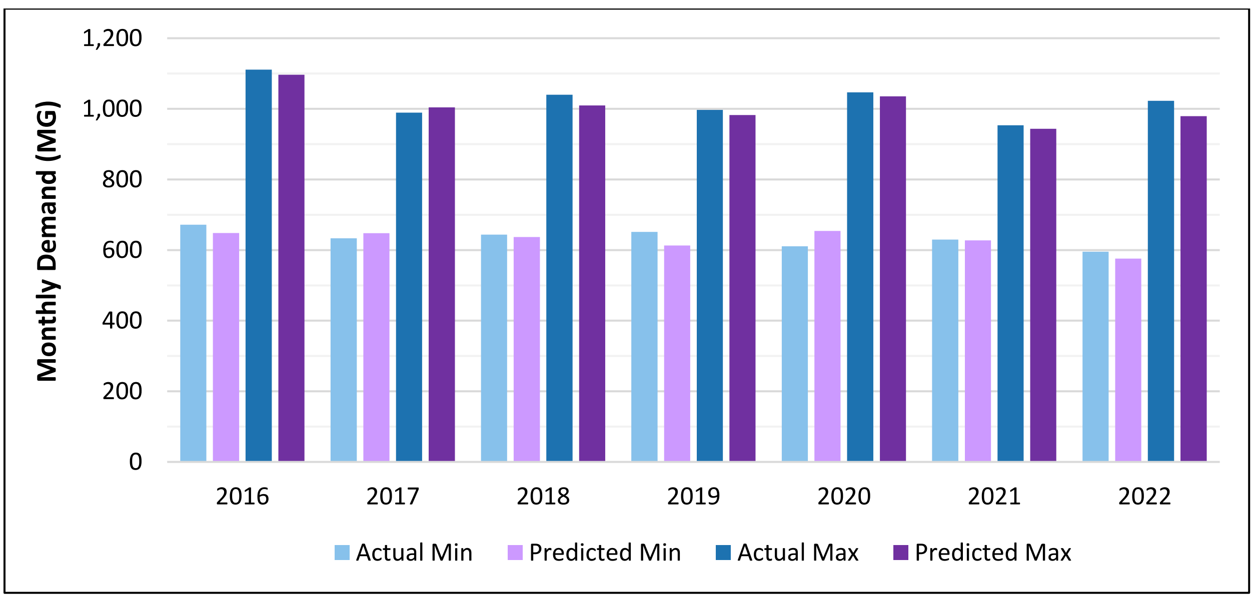


Figure 5. Comparison of Historical Minimum and Maximum Monthly Demand to Predicted Demand from Statistical Model

3.3 Projections for Explanatory Variables

After statistical analysis is complete and the econometric function with the highest correlation to water use is identified, projected values for the explanatory variables can be applied to project future water demands. The statistically significant explanatory variables with the highest correlation to per capita water demand for the OCPC planning area were identified as:

- Weather Data
  - Average maximum temperature (TMAX)
  - Number of days in a month above 85°F
  - Total monthly precipitation (in inches)
  - Total monthly precipitation in previous month
- Passive Conservation
  - Indoor plumbing efficiency index
- Binary Variable
  - Summer months (June, July, and August)

For this analysis, historical monthly averages were used for the climate variables to generate the baseline demand projections; projected changes in climate will be captured as part of the scenario planning process (see **Section 6**). Therefore, the efficiency index is the only independent variable which is projected to change over time in the baseline demand projection (also known as passive conservation).

The projected values for the efficiency index were derived using the same methodology as the historical efficiency index, discussed in **Section 2.5**. The baseline demand projections use an efficiency index as shown in **Table 8,** based on current plumbing efficiency standards with the same base year of 1993. Alternate scenarios were developed (see **Section 6**) which account for improvements in efficiency beyond current requirements based on currently available fixtures/appliances with lower flow rates and/or estimated flow rates for future models with even higher efficiency than what is currently available on the market.

Table 8. Projected Efficiency Index for OCPC Planning Area, 2025 to 2050

Year	Indoor Use (GPCD)	Efficiency Index
2025	59	0.66
2030	55	0.62
2035	53	0.59
2040	51	0.57
2045	50	0.55
2050	48	0.54

3.4 Population Projections

The statistical function calculates projected demands on a per capita basis; therefore, population change is not an independent variable in this analysis. However, population is a driver of demand and is incorporated by multiplying projected per capita demand by projected population. As a result, changes in both the explanatory variables and population are captured in this analysis.

Projected population was acquired from the Umass Donahue Institute for each member community from 2020 to 2050. Population projections are provided in five-year intervals, so population was linearly interpolated for years in between the projected intervals. The population projections align well with the historical population served data for all communities except for Abington and Plymouth; the population for Abington in 2020 reported by Umass is approximately 16,300 lower than the population served while the population for Plymouth in 2020 reported by Umass is approximately 17,700 higher than the population served. Therefore, the population projections for those two communities were adjusted to better align with the historical population served data while maintaining the same total projected population for the OCPC planning area.

The population served for the OCPC planning area is projected to increase 1.6 percent between 2025 and the peak in 2035 of 402,960 people, after which point the population is estimated to slowly decrease back down under 400,000 by 2050, as shown in **Table 9**. Many communities are approaching build-out conditions, if not realized already. This constrains potential growth unless there are significant changes in zoning regulations and a shift towards redevelopment focused on multifamily housing or high-density development.

Table 9. Projected Population Served by OCPC Community, 2025 to 2050

Community	2025	2030	2035	2040	2045	2050
Abington	34,941	35,790	36,518	37,144	37,747	38,445
Avon	4,680	4,584	4,448	4,306	4,162	3,995
Bridgewater	28,545	28,677	28,901	29,046	29,037	28,951
Brockton	106,973	108,092	108,873	109,512	110,408	111,657
Duxbury	15,728	15,713	15,818	15,860	15,656	15,210
East Bridgewater	14,623	14,832	14,894	14,835	14,643	14,466
Easton	24,328	23,815	23,423	22,928	22,271	21,543
Halifax	7,750	7,728	7,625	7,441	7,206	6,970
Hanover	14,732	14,849	14,976	15,001	14,838	14,588
Hanson	10,672	10,772	10,834	10,738	10,524	10,322
Kingston	14,189	14,829	15,415	15,752	15,861	15,880
Pembroke	18,332	18,377	18,297	18,028	17,608	17,208
Plymouth*	49,205	50,921	51,749	51,780	51,338	50,640
Stoughton	28,999	28,599	28,051	27,423	26,704	25,950
West Bridgewater	7,815	7,938	8,082	8,231	8,343	8,418
Whitman	15,135	15,146	15,056	14,890	14,682	14,452
Total	**396,647**	**400,662**	**402,960**	**402,915**	**401,028**	**398,695**

*includes population for North Plymouth Public Water System (PWS).
Note: Plympton has no PWS, so population was not included for the community in the baseline projections.

4.0 Demand Projections for OCPC Planning Area

Projected values for the independent variables were compiled in a monthly time series from January 2025 to December 2050 for the OCPC Planning Area and input into the econometric function to calculate projected GPCD by month across the planning horizon. The projected GPCD values were multiplied by projected population and number of days for the corresponding month to calculate projected water consumption by month for the OCPC planning area. Monthly values were summed by year to calculate the projected annual consumption.

After projecting consumption, the analysis integrated Unaccounted for Water (UAW) data sourced from MassDEP[6] (2016-2022). The data from MassDEP is comprised of percent UAW values reported by communities and adjusted by MassDEP as necessary[7]. The average volume of UAW by community was calculated from the percent UAW dataset and the volume of historical total demand. Average volume of UAW for all communities' totals to 1,541 million gallons per year (MGY). This was held constant across the planning horizon because using a constant percentage of UAW results in the volume of UAW decreasing over time as demands decrease. UAW decreasing over time is not realistic as the age of water systems increases unless significant and continued investments are made in leak detection and repair.

The projected monthly water consumption plus the average volume of UAW by month were summed to calculate total demand, as shown in **Table 10**, and illustrated in **Figure 7**. Projected consumption in 2025 is consistent with total consumption in recent years for the OCPC planning area and is projected to decrease across the planning horizon due to continued improvements in water use efficiency. Despite the slight increase in population, total demands are not projected to increase for the OCPC planning area through 2050.

Table 10. Projected Demands for OCPC Planning Area, 2025 to 2050

Year	Projected Consumption (MG)	UAW (MG)	Total Demand (MG)
2025	9,024	1,541	10,566
2030	8,151	1,541	9,693
2035	7,539	1,541	9,080
2040	7,078	1,541	8,619
2045	6,718	1,541	8,259
2050	6,441	1,541	7,983

[6] Available at: https://www.mass.gov/doc/rgpcd-and-uaw-spreadsheet-0/download

[7] "The most common reason MassDEP adjusted the UAW values upward is that water suppliers did not provide sufficient documentation of unmetered water used for municipal purposes, such as firefighting, water main flushing, and water main breaks. Many water suppliers counted water lost to leaks as a municipal use. However, MassDEP considers leaks to be UAW, and therefore discounted leaks as a municipal use, resulting in higher UAW values" – MassDEP. From webpage: https://www.mass.gov/info-details/public-water-supply-tools-resources-performance-standards

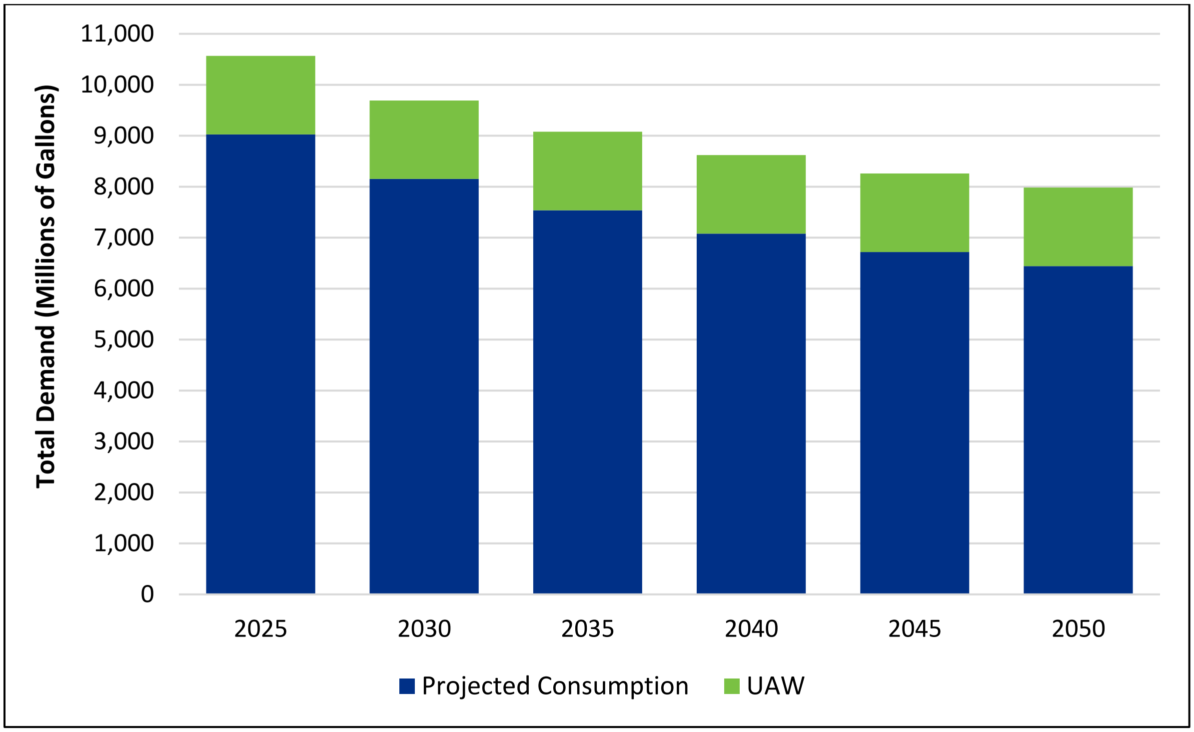


Figure 7. Projected Consumption and UAW for OCPC Planning Area, 2025 to 2050

5.0 Demand Projections by Member Community

Annual demands were disaggregated by member community based on the projected population served for each community and projected per capita consumption for each year. The projected per capita consumption was derived from the projected total annual consumption for the OCPC planning area divided by the projected total population served. UAW was based on the historical average volume of UAW for each community from the MassDEP data.

The results of projected demands by community were compared to historical demands by community to gauge the reasonableness of the community-level projections. For some communities, the projected demands exhibited a significant deviation from historical demands that did not appear reasonable. Therefore, an adjustment factor was applied for those communities based on the ratio of average annual historical demand to the projected demand in 2023. Total demands for the OCPC planning area were revised based on the sum of the revised projected demands by community, which increased demands by approximately 1.65 MGD across the planning horizon.

Projected demands by community are shown, with a corresponding graph of historical and projected population served, in **Figure 8** through **Figure 39**. Based on this analysis, all communities in the OCPC planning area are projected to have demands decrease across the planning horizon. The minimal increase in population served and increased water use efficiency over the planning horizon produces a downward trend in water demand for the OCPC planning area through 2050.

Figure 8. Historical and Projected Demands for Abington

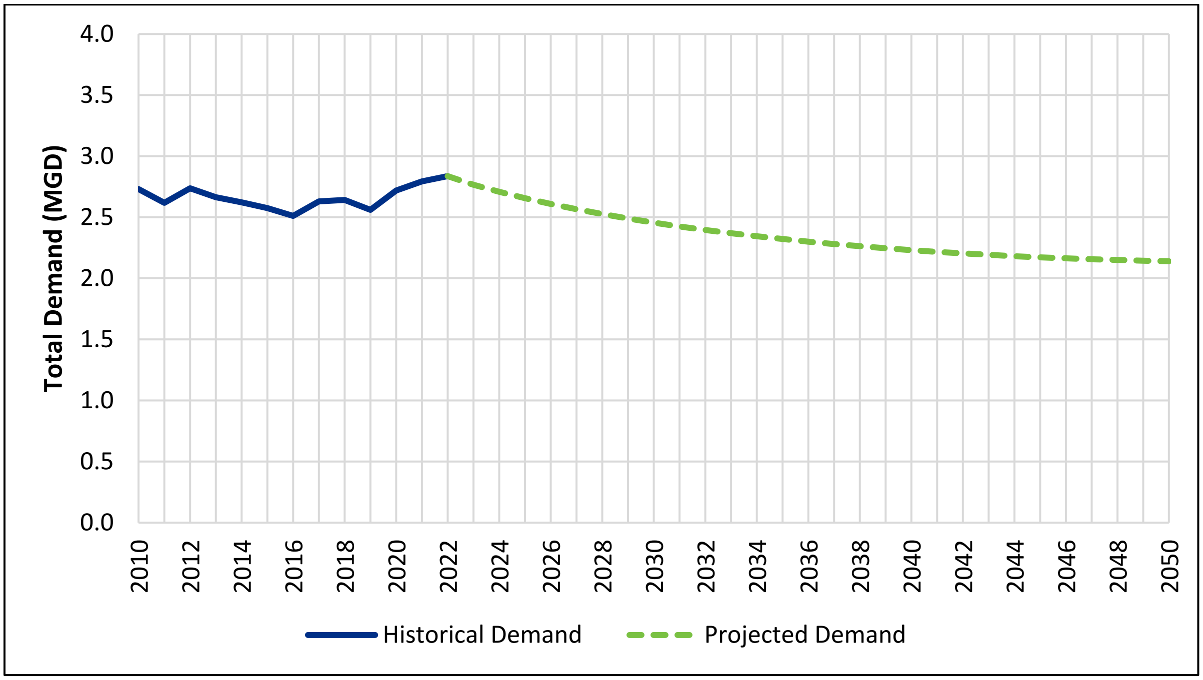


Figure 9. Historical and Projected Population Served for Abington

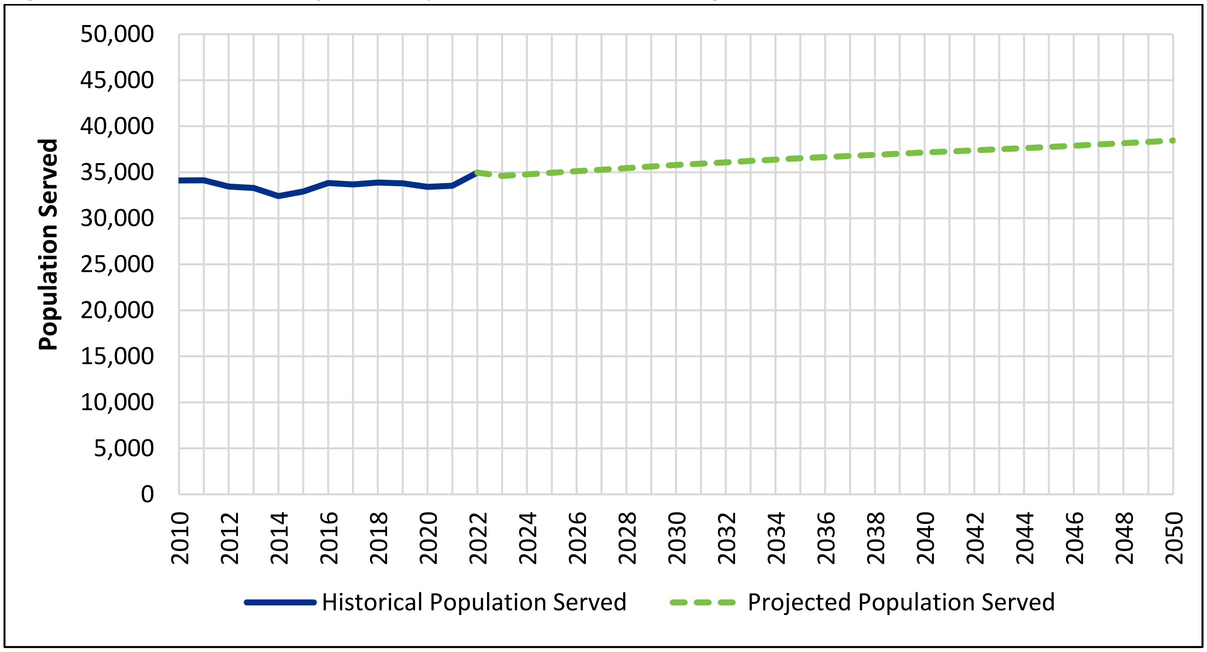


Figure 10. Historical and Projected Demands for Avon

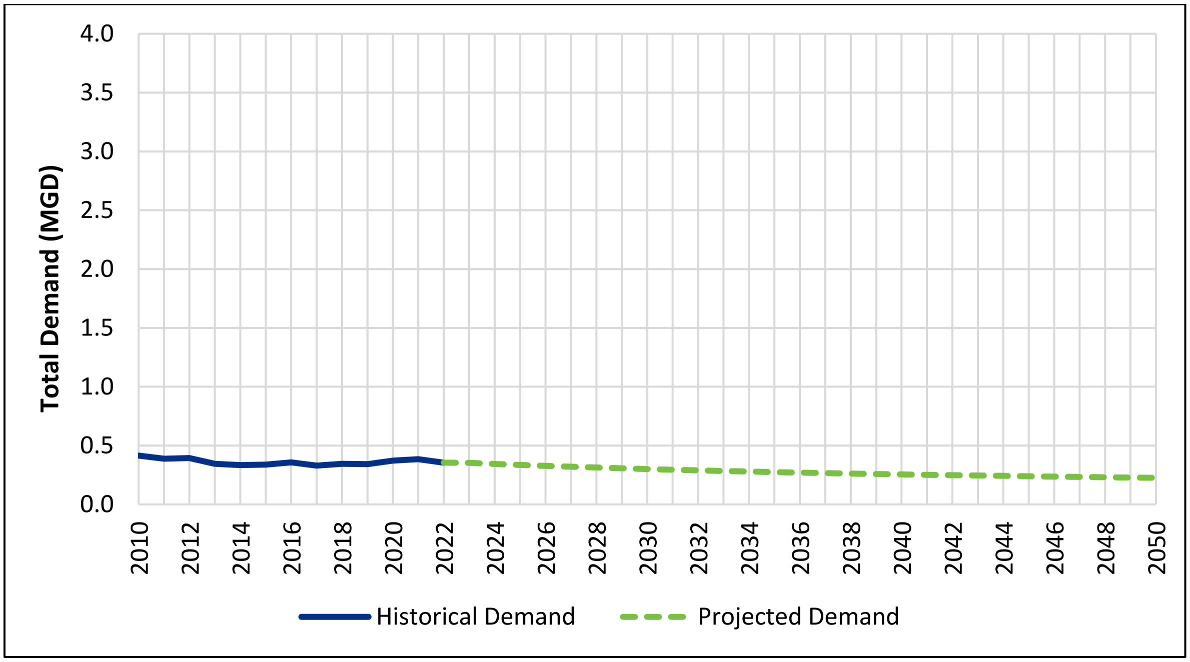


Figure 11. Historical and Projected Population Served for Avon

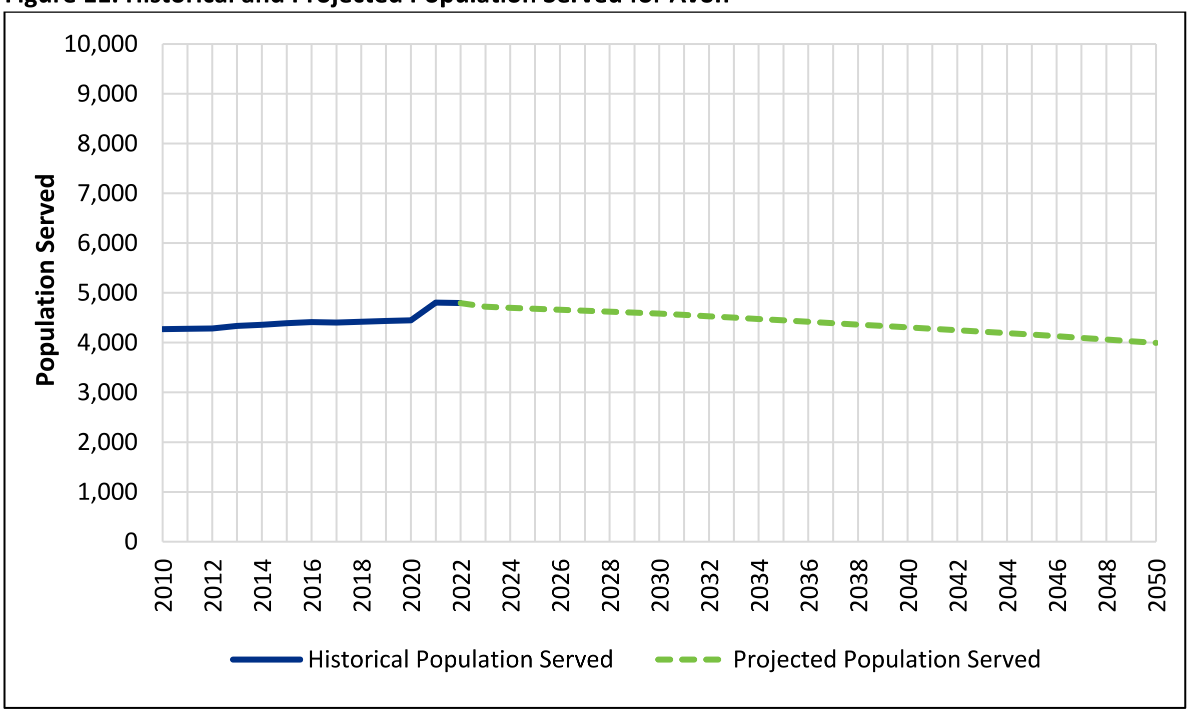


Figure 12. Historical and Projected Demands for Bridgewater

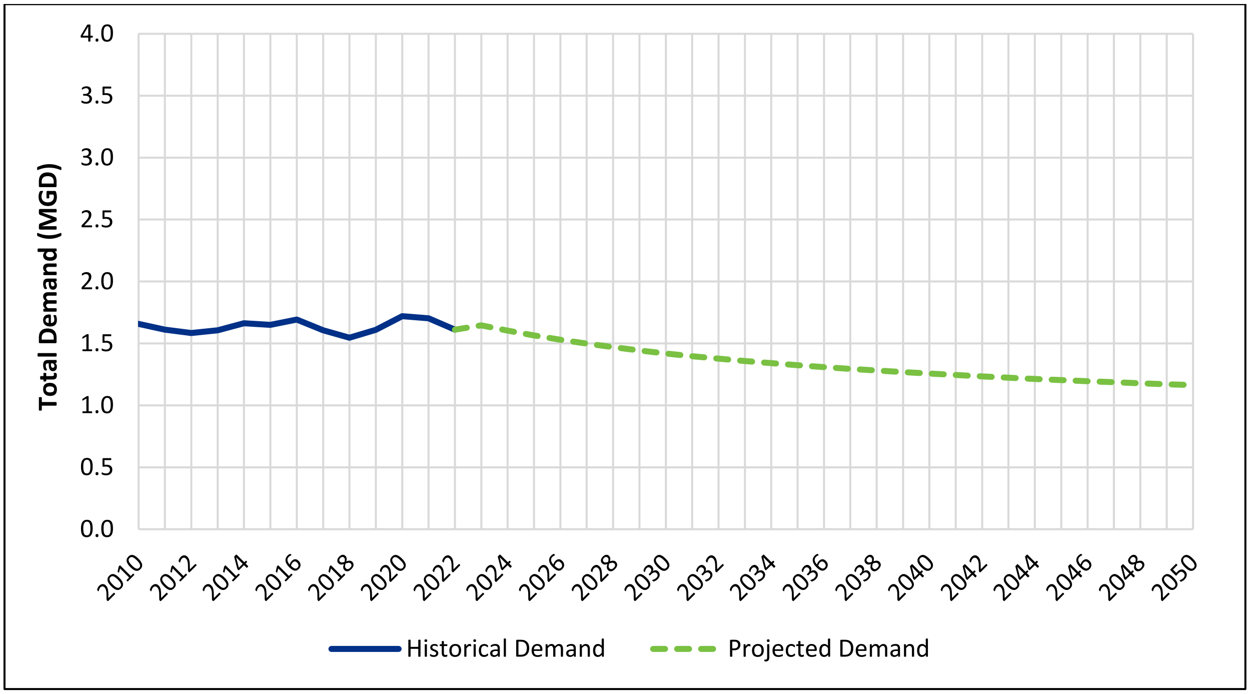


Figure 13. Historical and Projected Population Served for Bridgewater

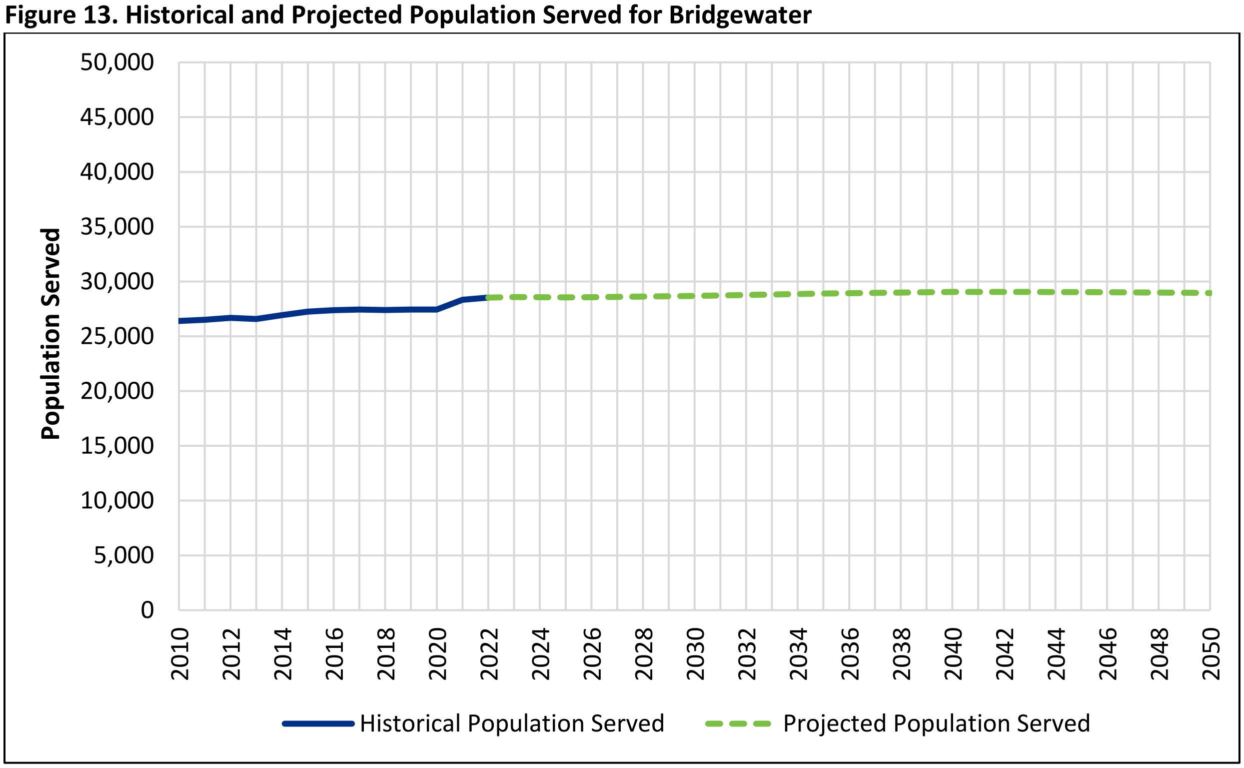


Figure 14. Historical and Projected Demands for Brockton

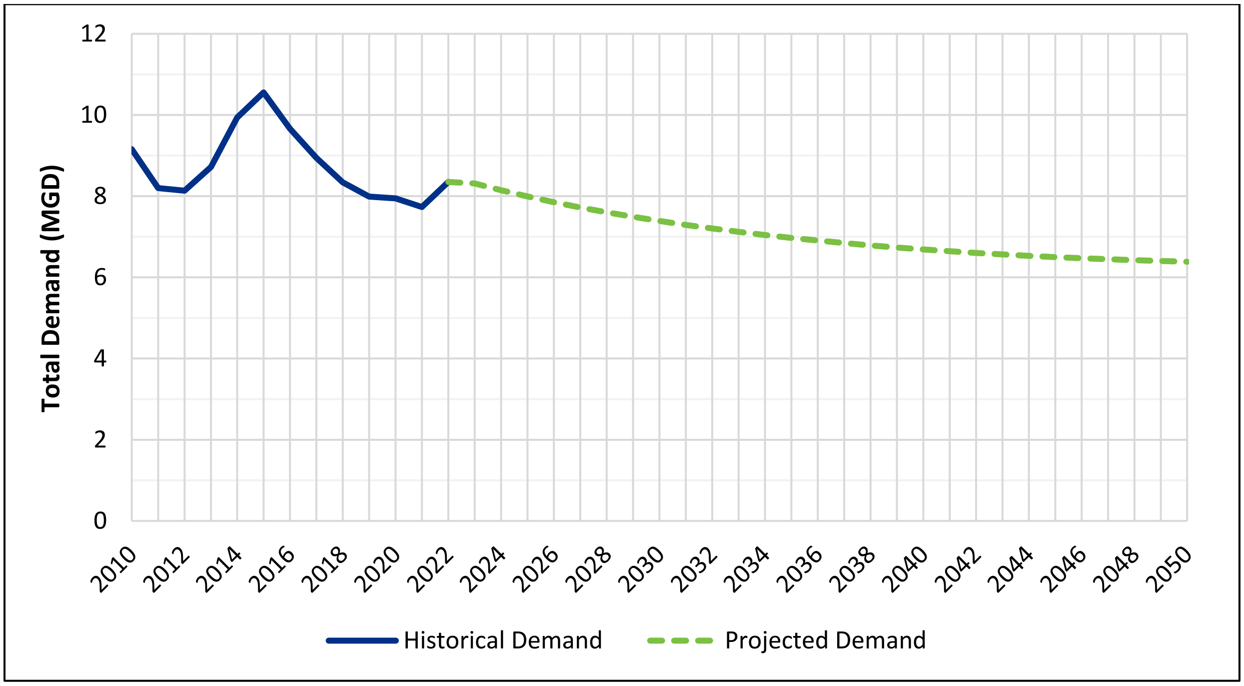


Figure 15. Historical and Projected Population Served for Brockton

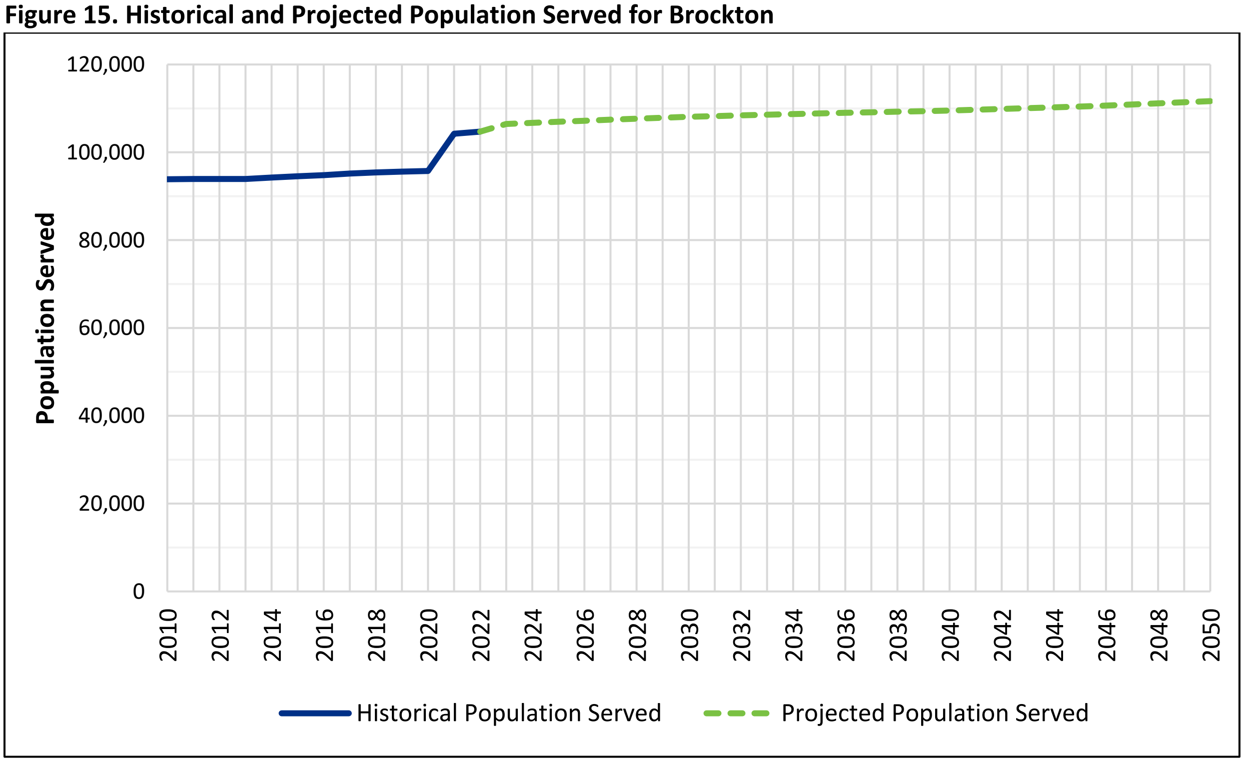


Figure 16. Historical and Projected Demands for Duxbury

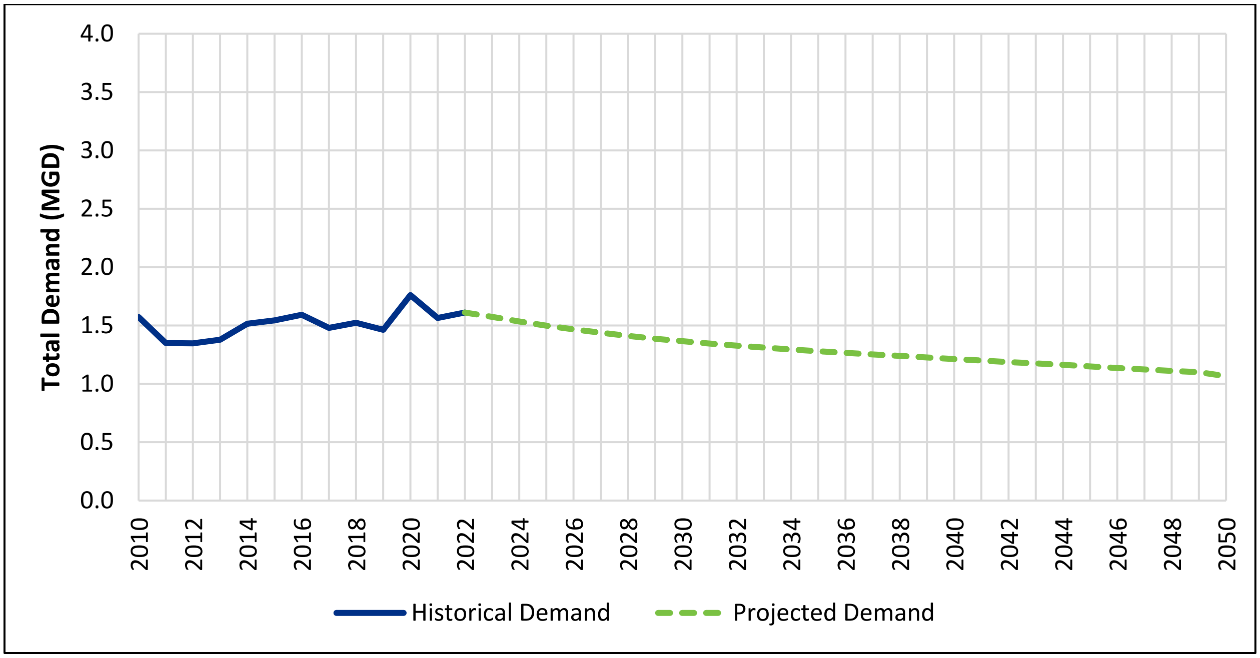


Figure 17. Historical and Projected Population Served for Duxbury

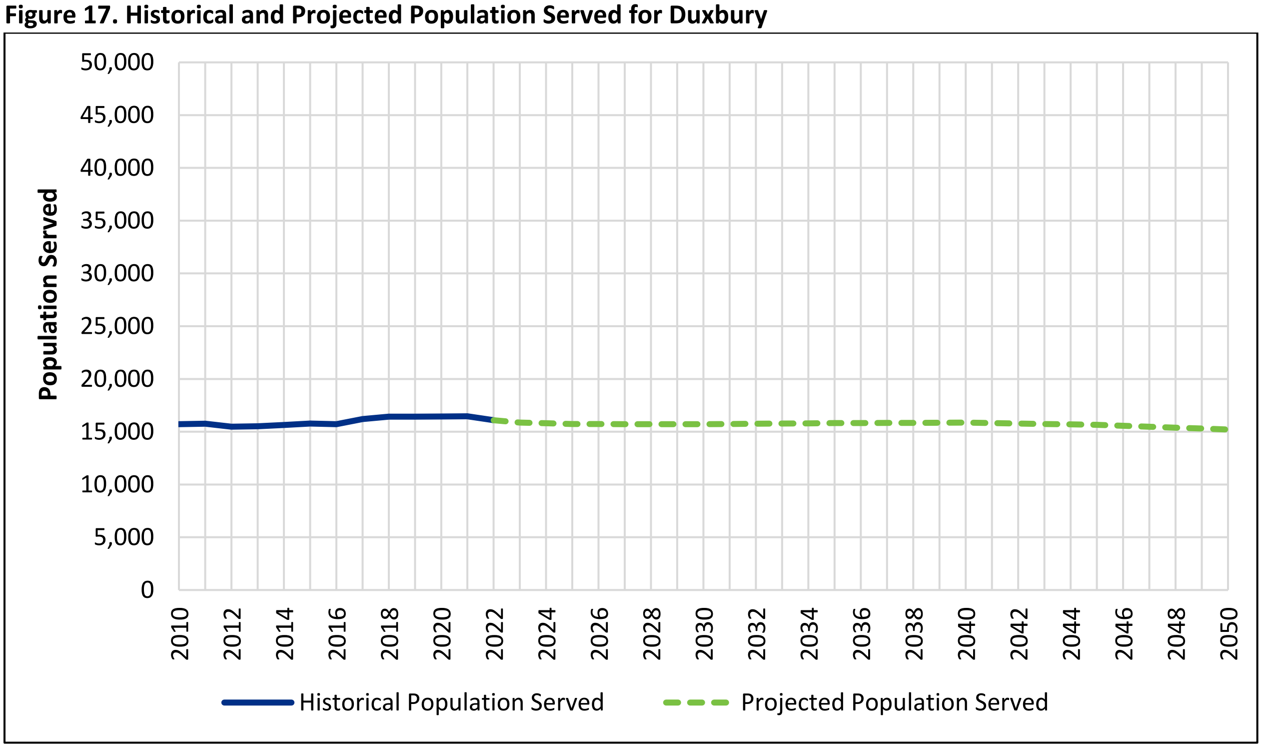


Figure 18. Historical and Projected Demands for East Bridgewater

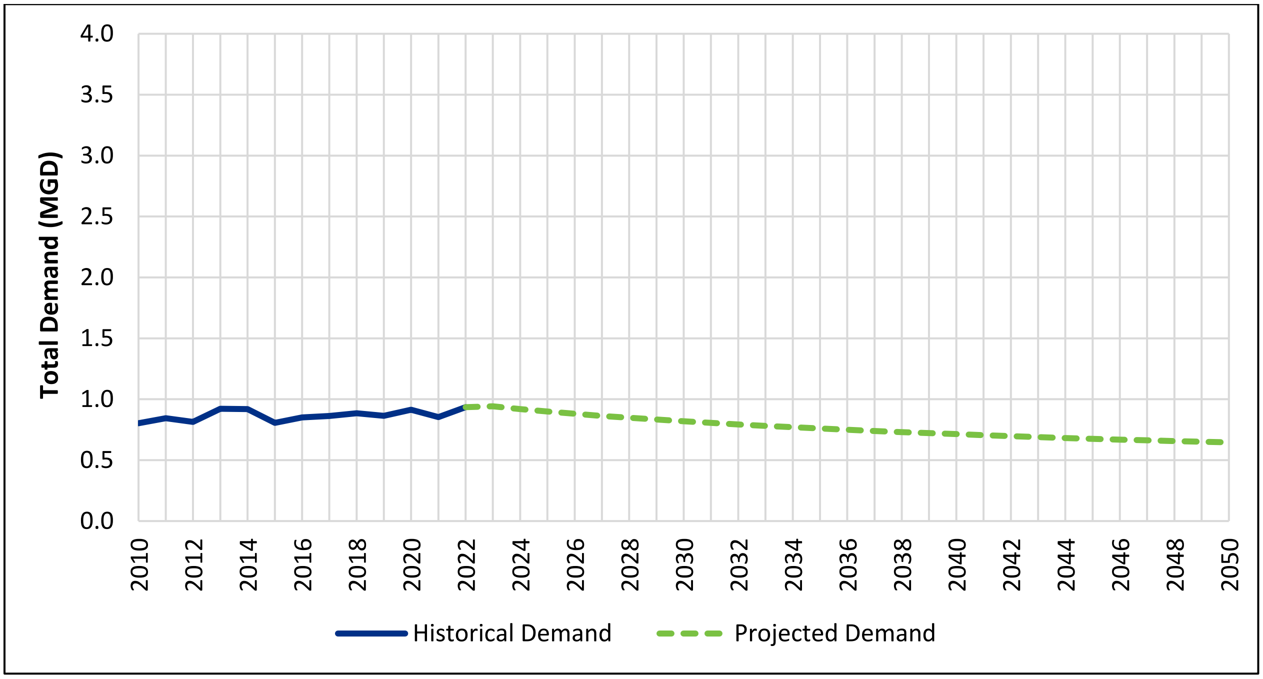


Figure 19. Historical and Projected Population Served for East Bridgewater

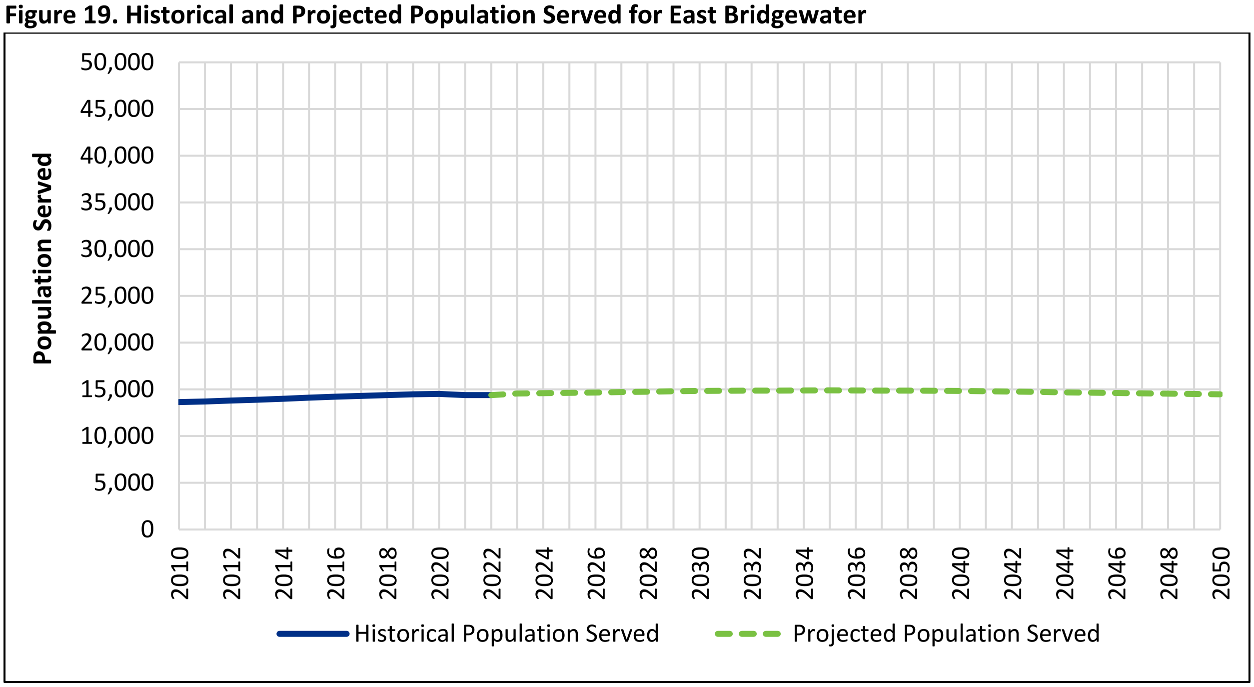


Figure 20. Historical and Projected Demands for Easton

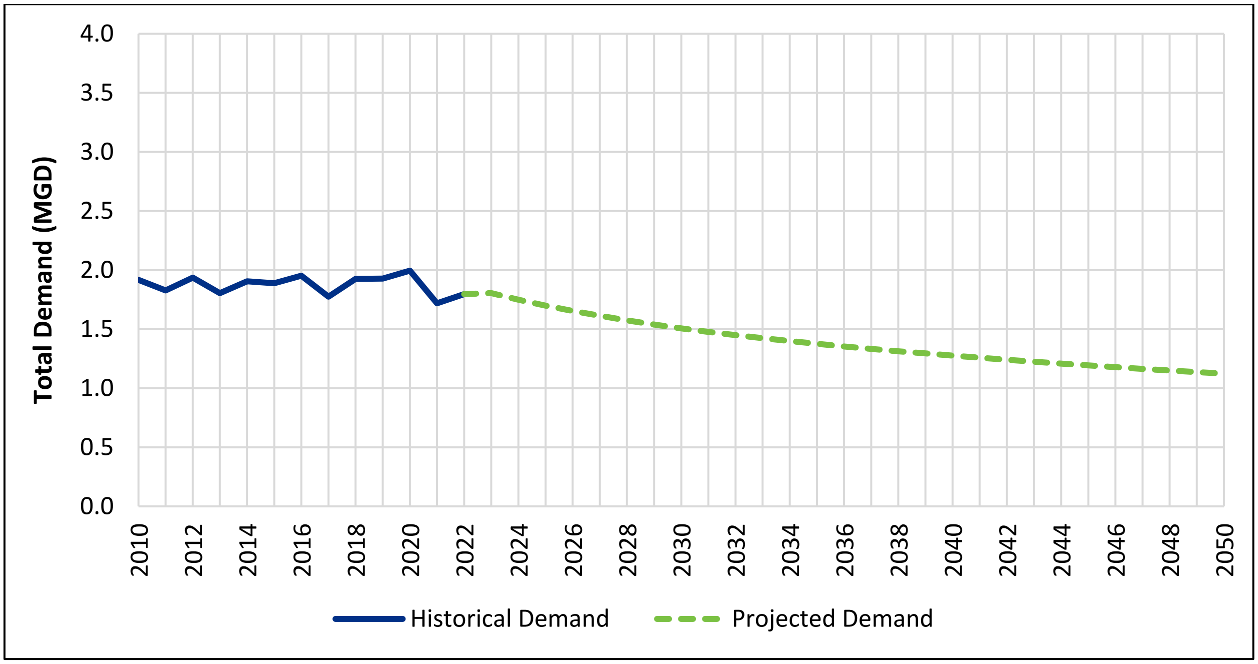


Figure 21. Historical and Projected Population Served for Easton

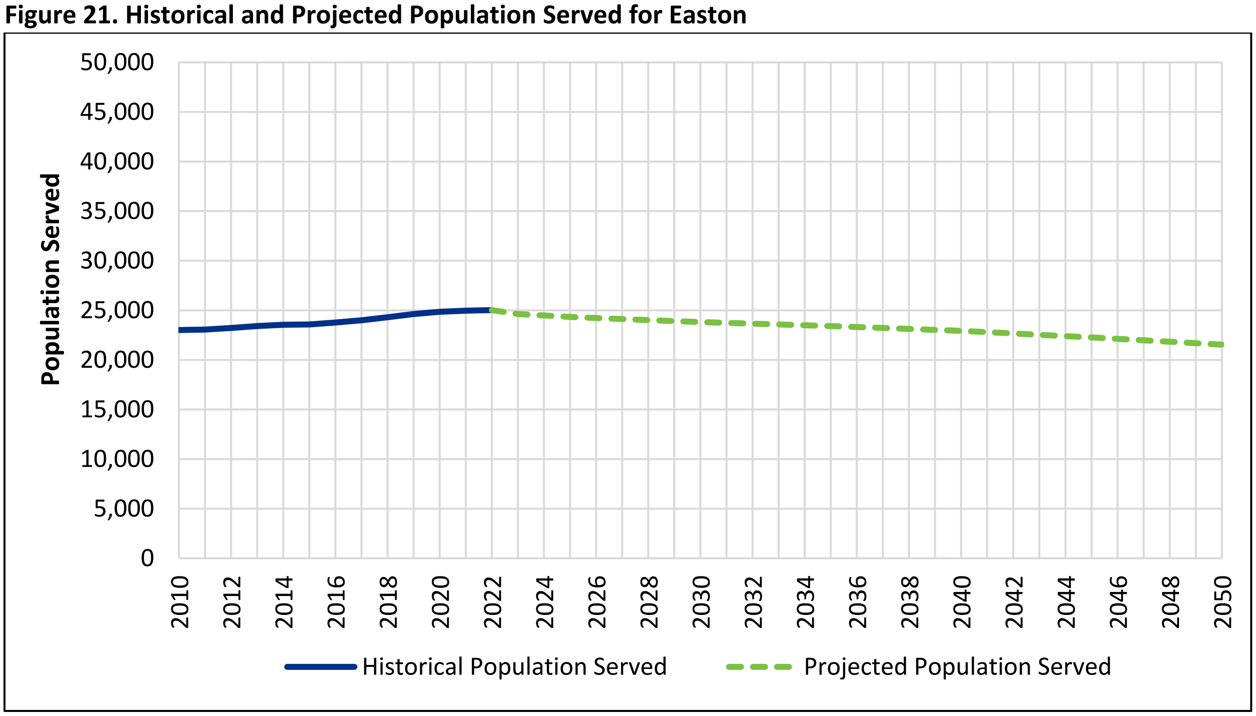


Figure 22. Historical and Projected Demands for Halifax

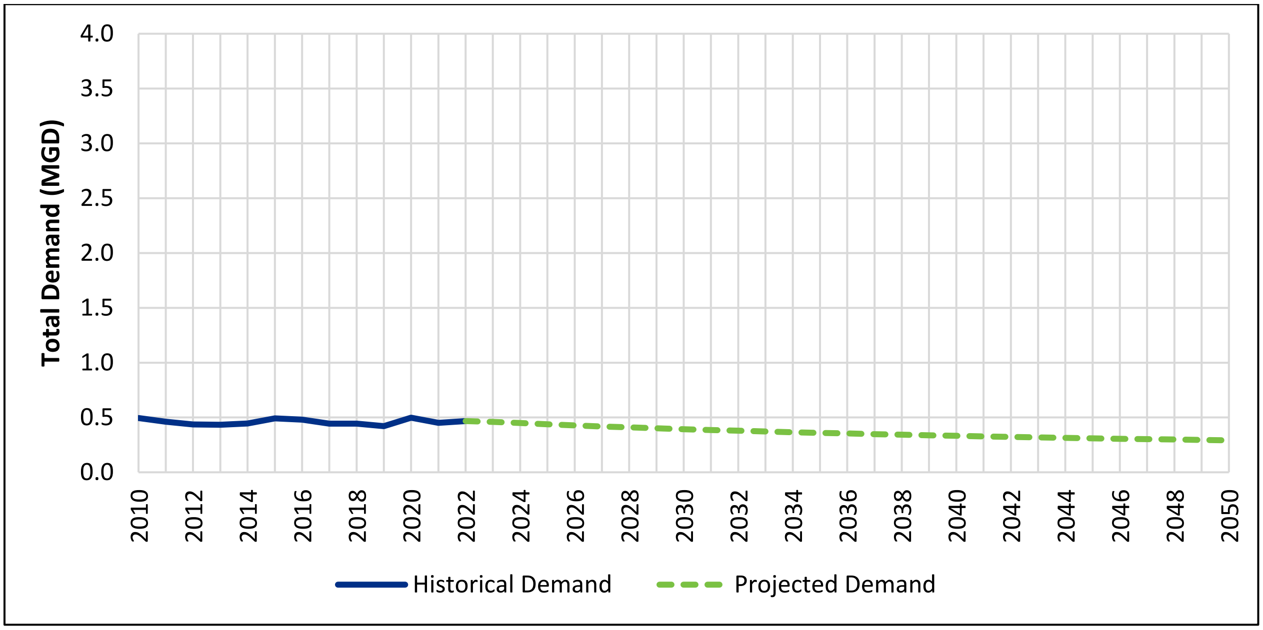


Figure 23. Historical and Projected Population Served for Halifax

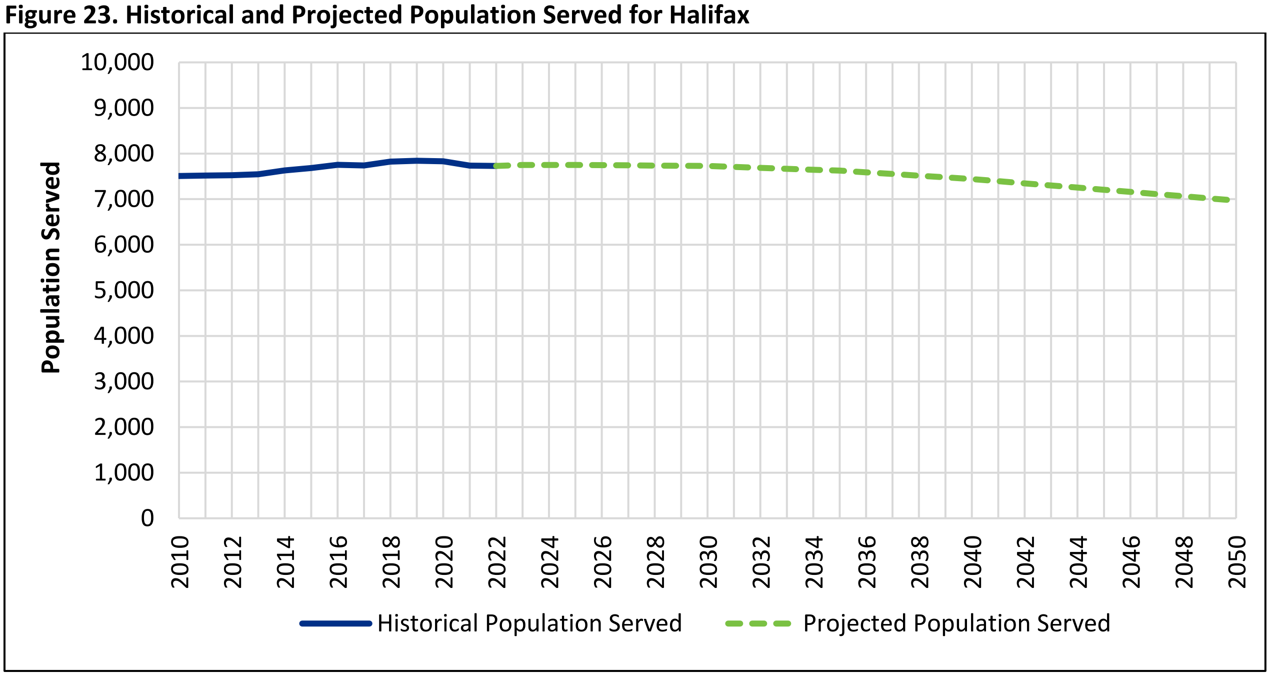


Figure 24. Historical and Projected Demands for Hanover

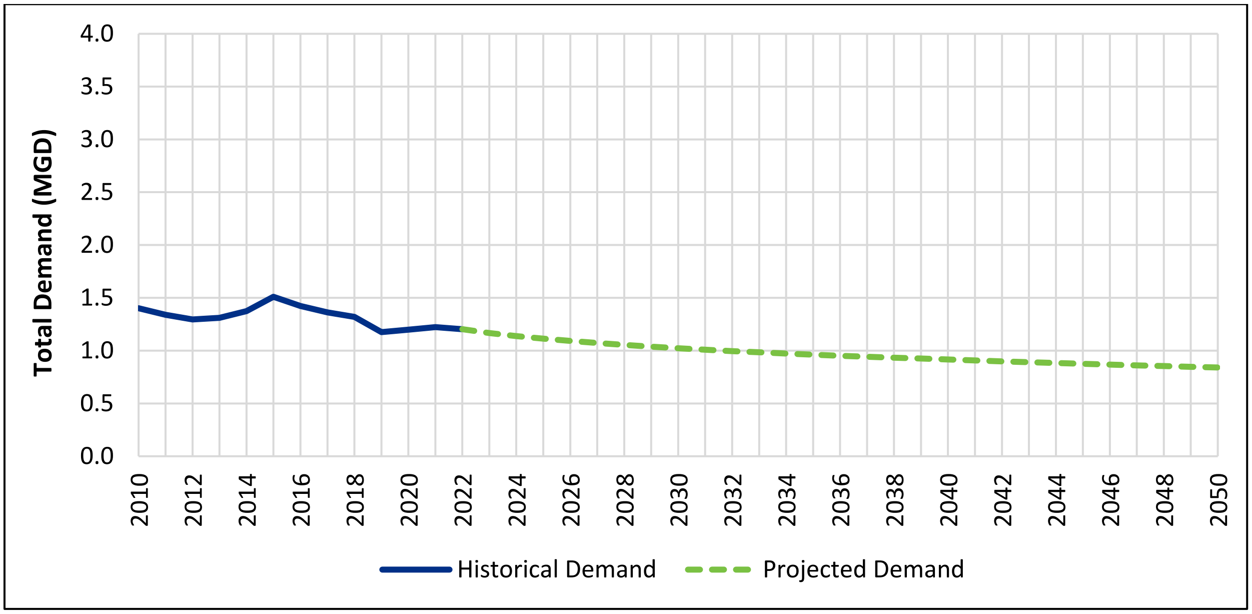


Figure 25. Historical and Projected Population Served for Hanover

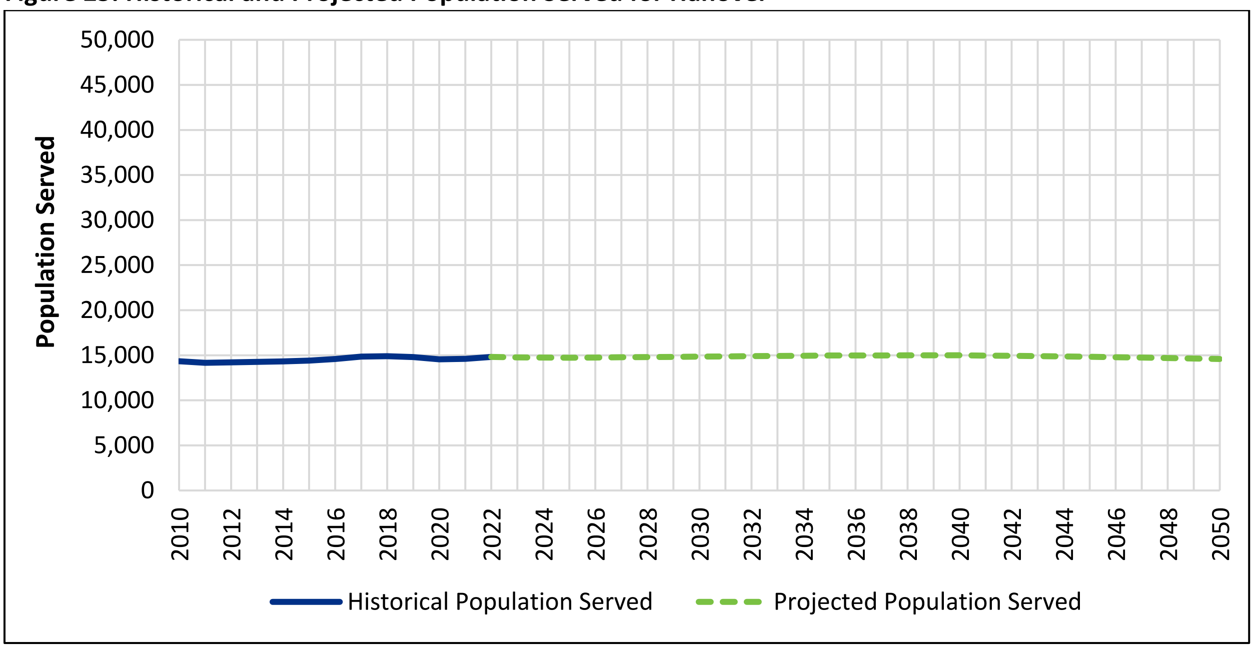


Figure 26. Historical and Projected Demands for Hanson

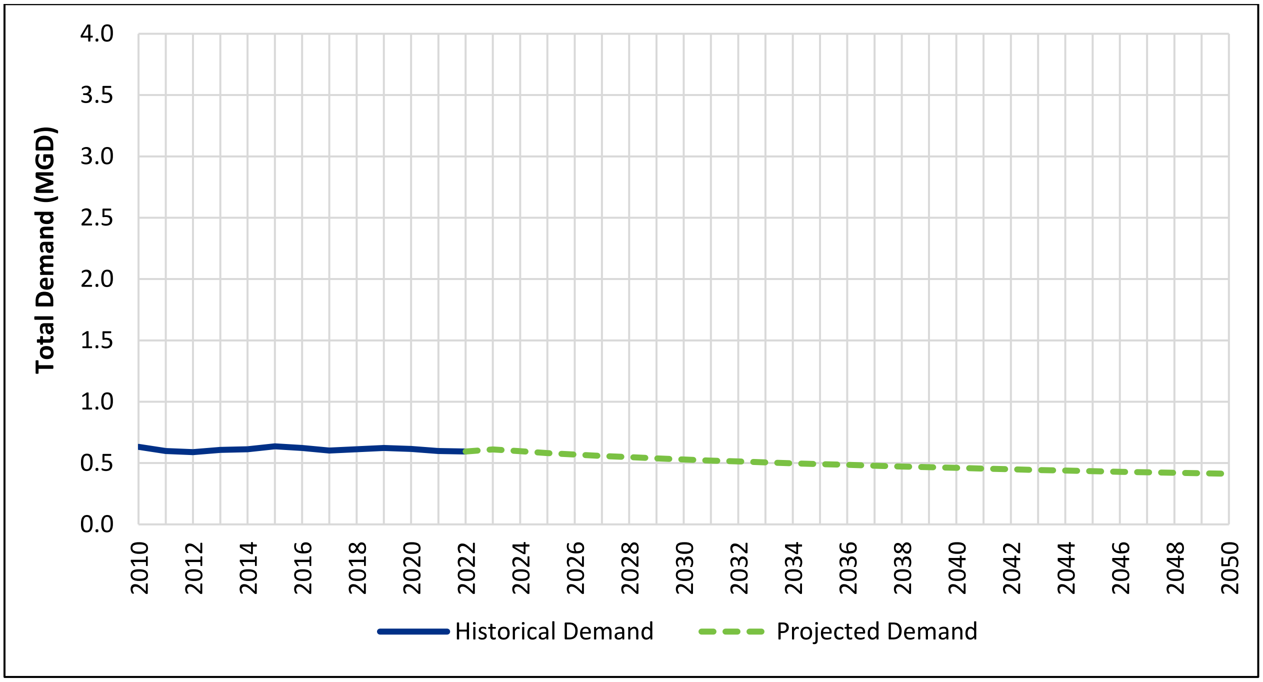


Figure 27. Historical and Projected Population Served for Hanson

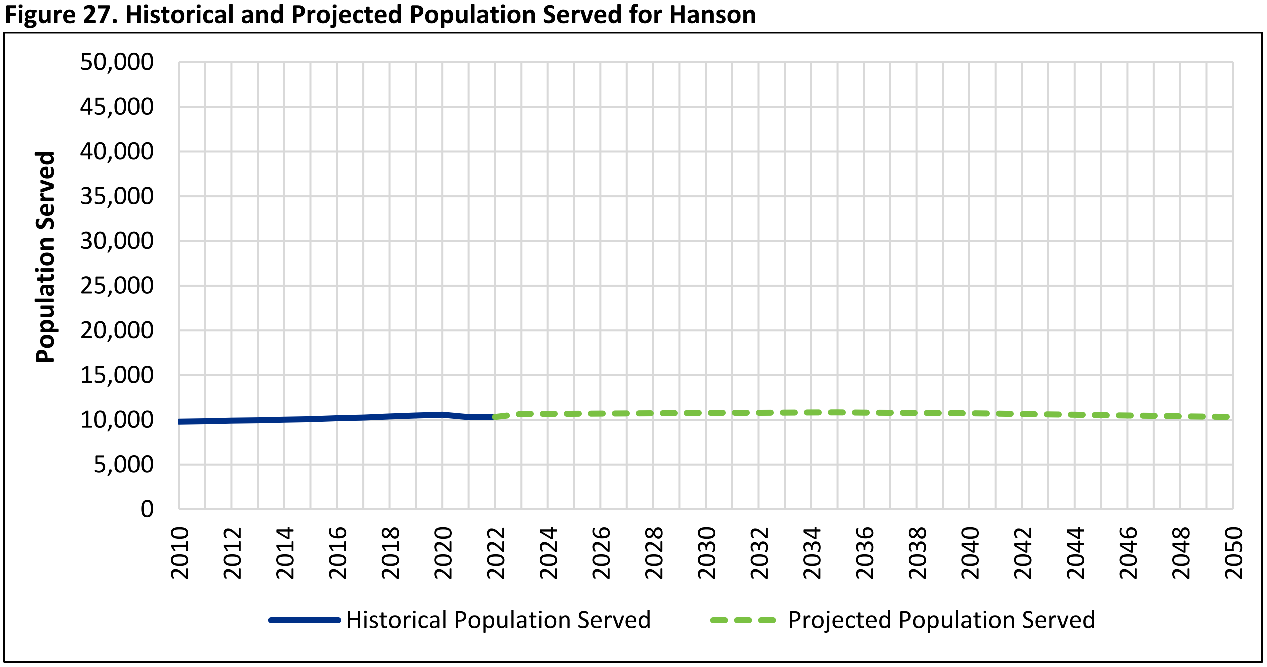


Figure 28. Historical and Projected Demands for Kingston

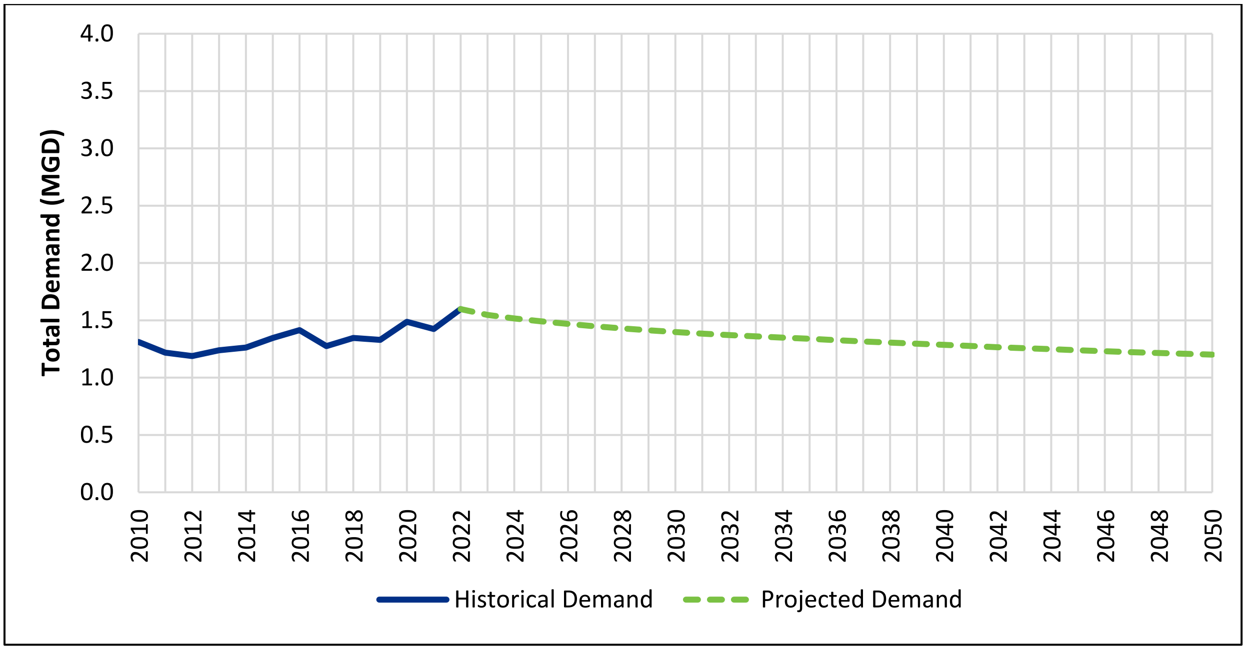


Figure 29. Historical and Projected Population Served for Kingston

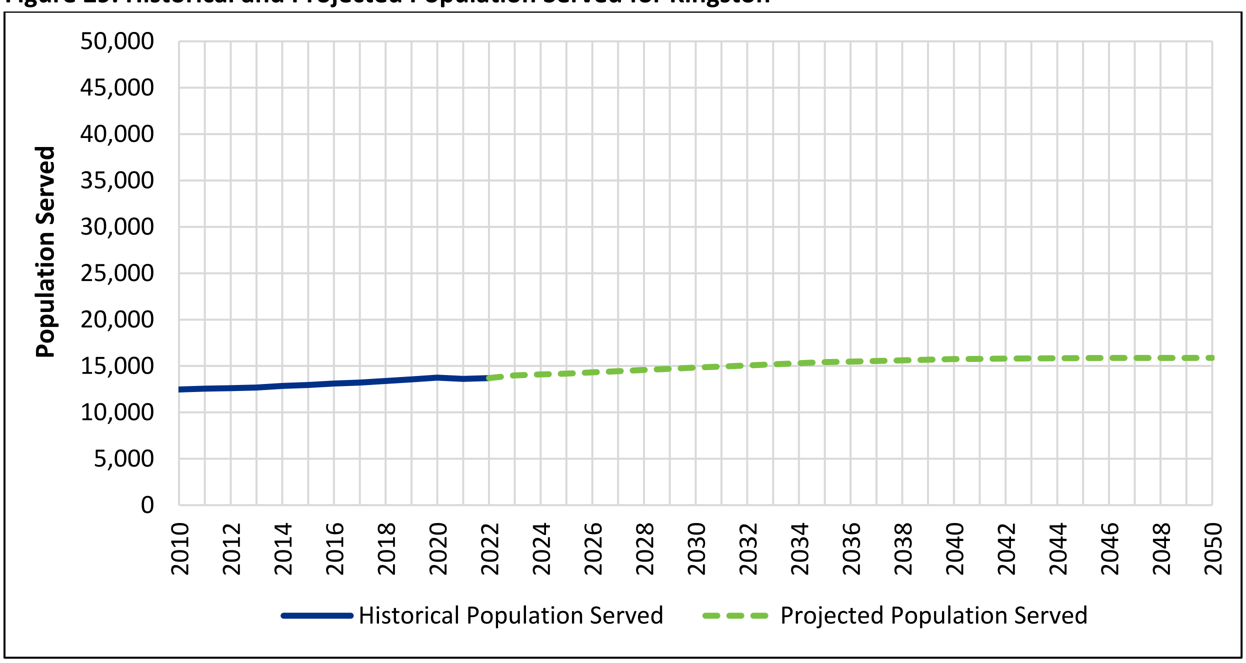


Figure 30. Historical and Projected Demands for Pembroke

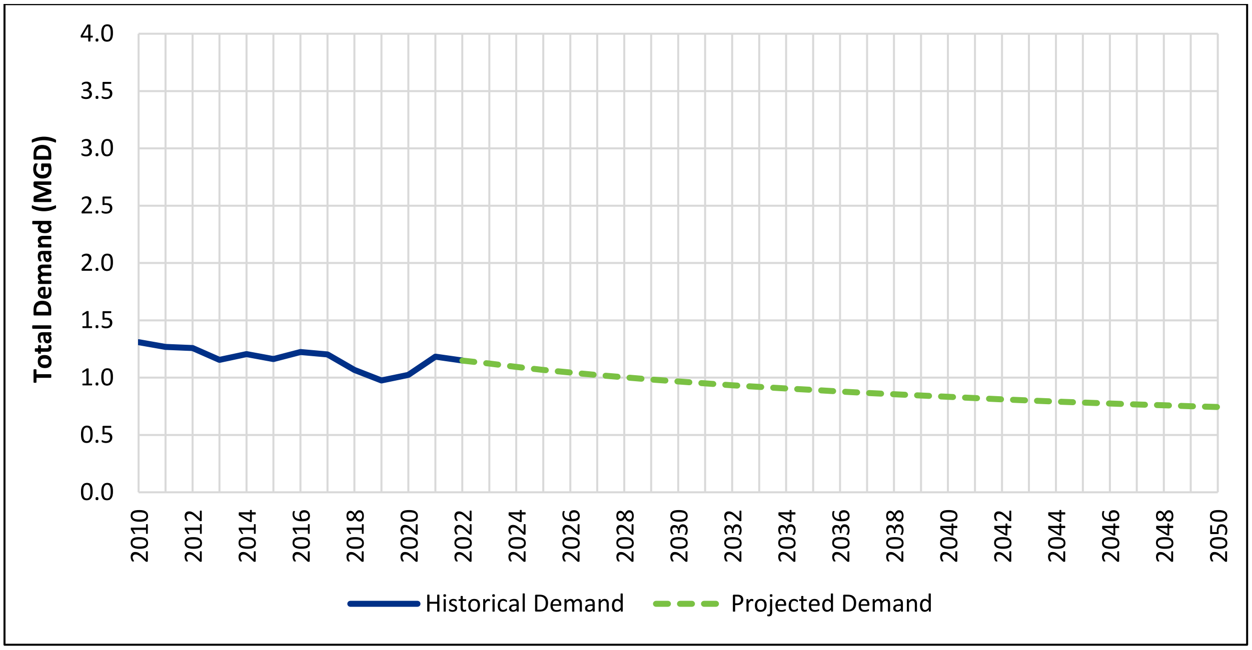


Figure 31. Historical and Projected Population Served for Pembroke

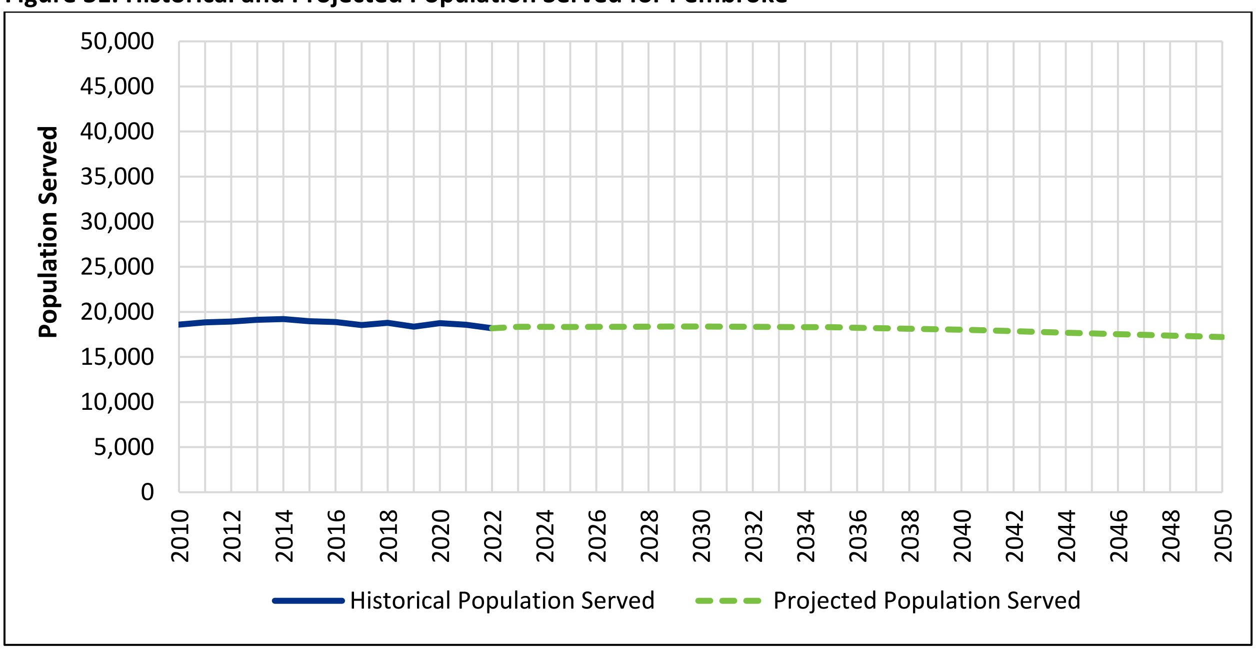


Figure 32. Historical and Projected Demands for Plymouth

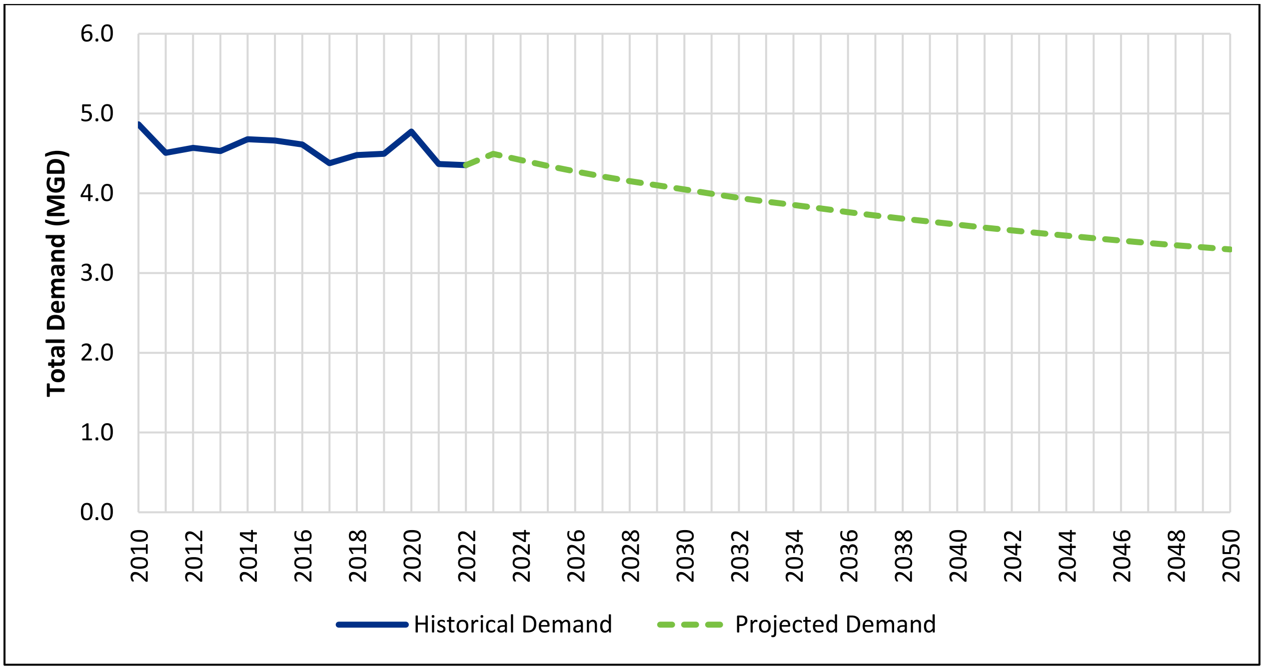


Figure 33. Historical and Projected Population Served for Plymouth

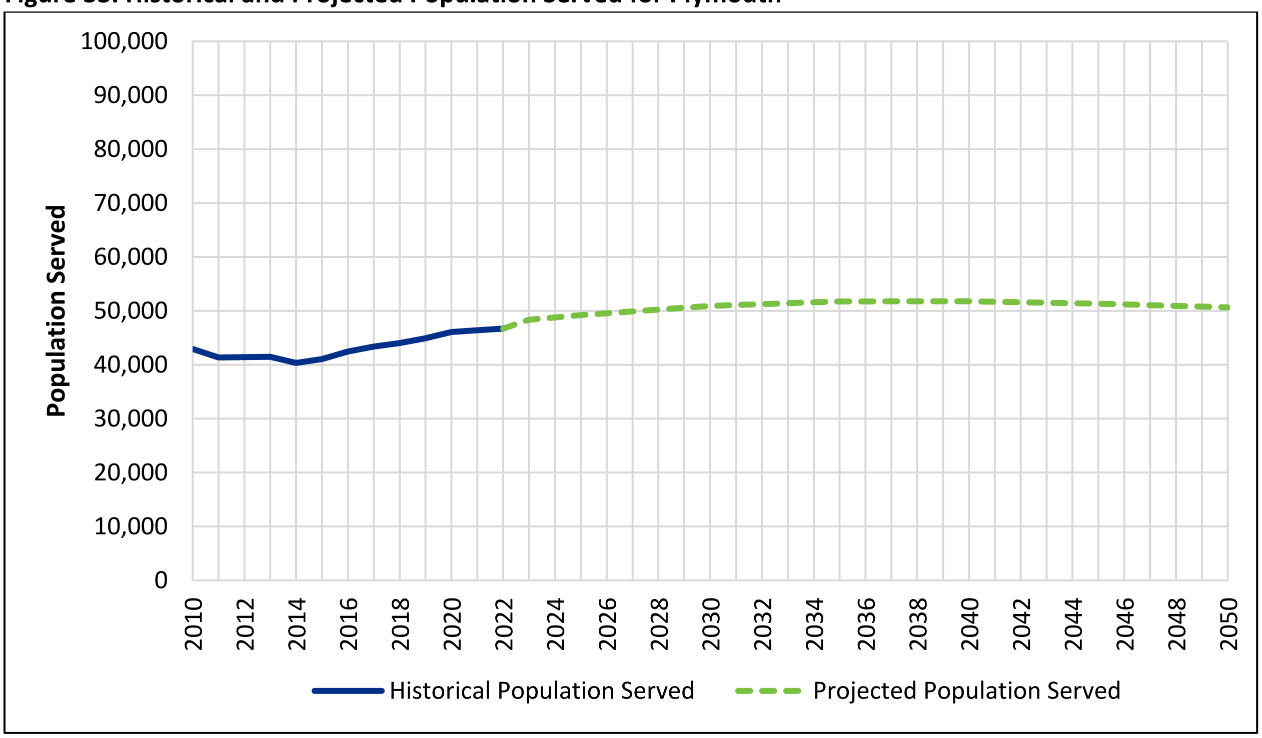
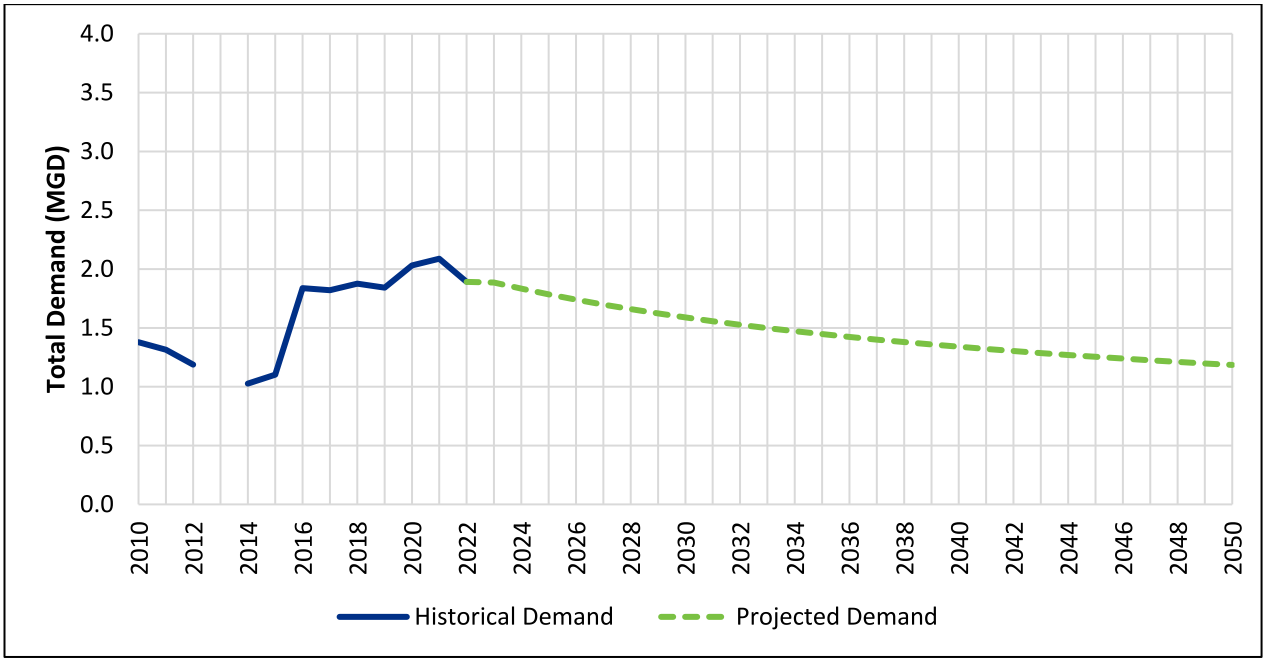


Figure 34. Historical and Projected Demands for Stoughton



Note: No historical data available for 2013

Figure 35. Historical and Projected Population Served for Stoughton

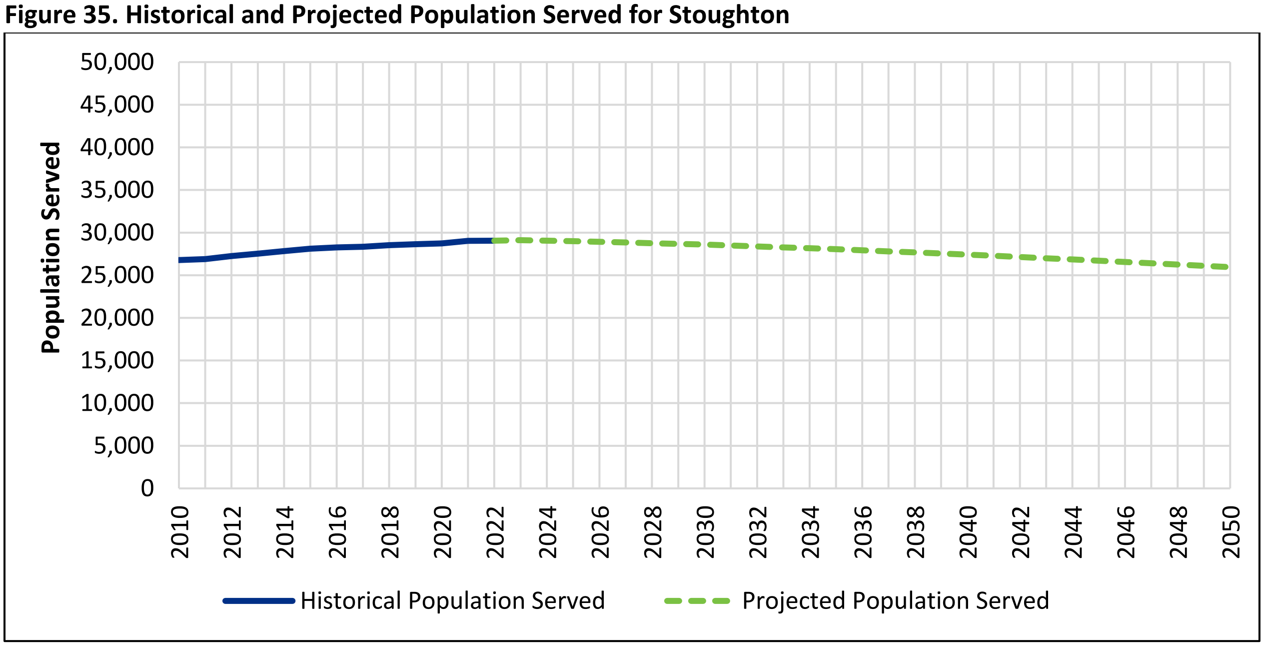


Figure 36. Historical and Projected Demands for West Bridgewater

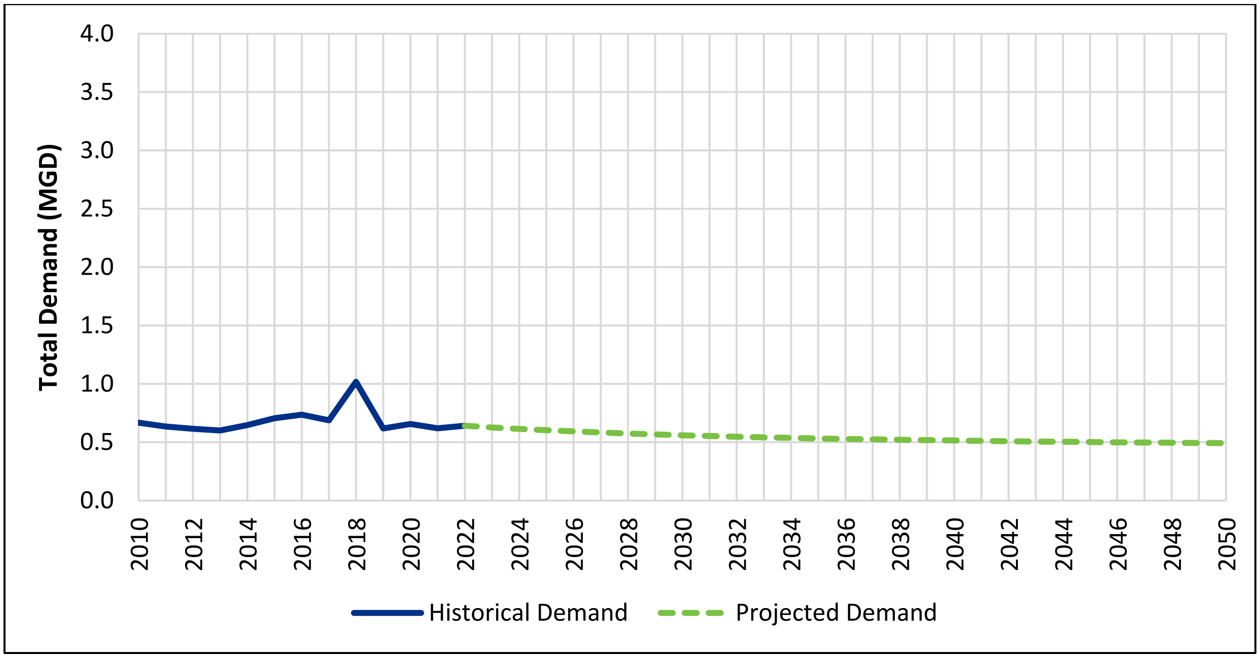


Figure 37. Historical and Projected Population Served for West Bridgewater

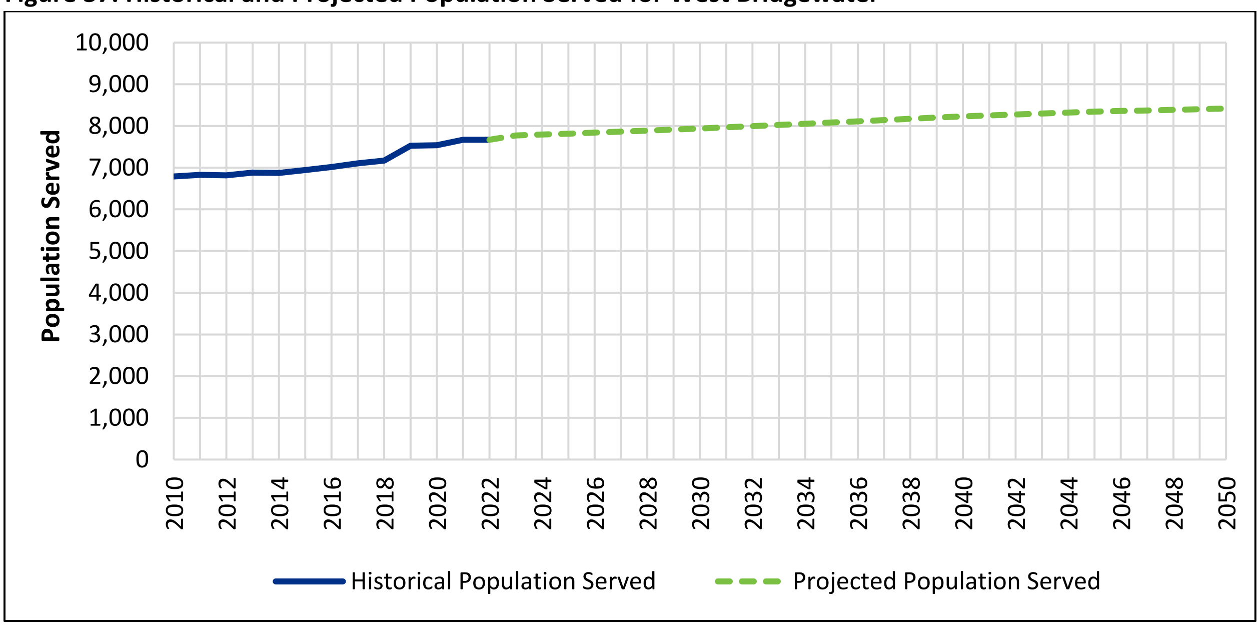


Figure 38. Historical and Projected Demands for Whitman

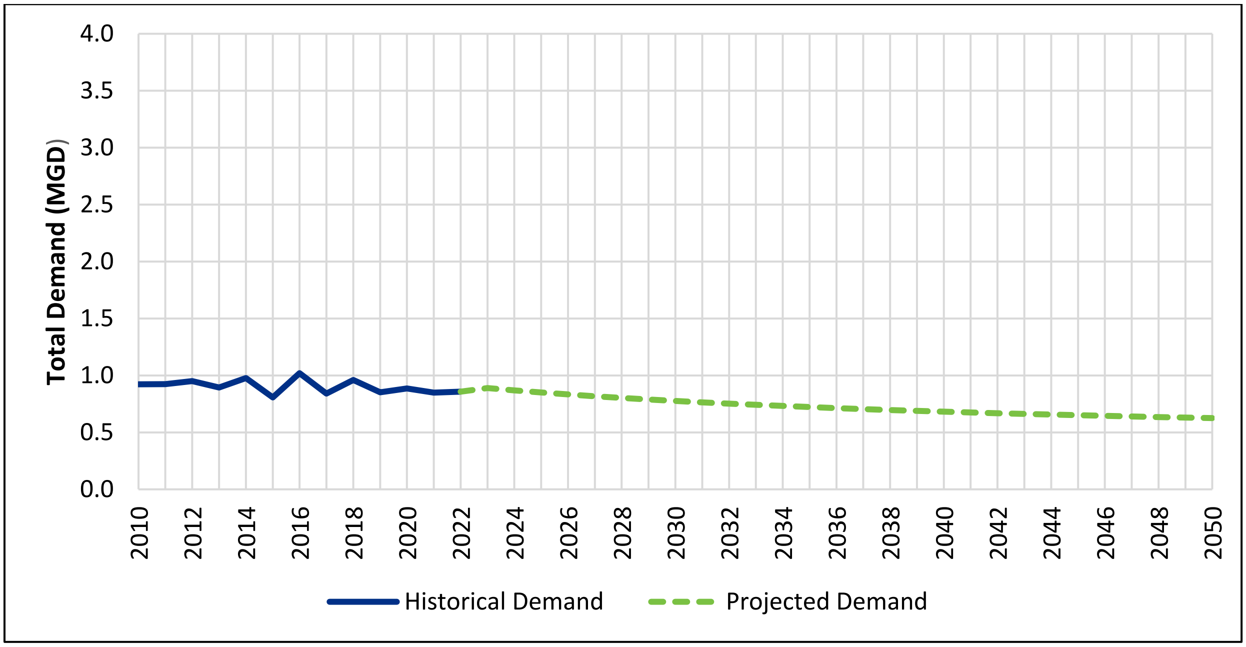
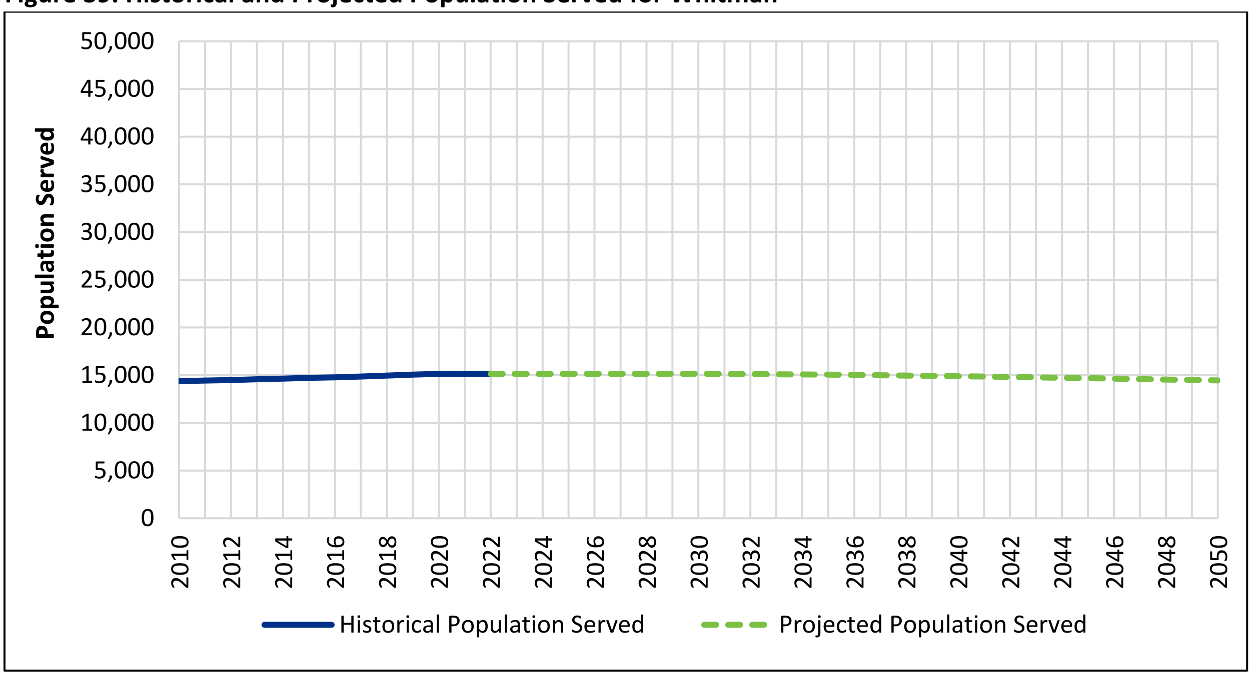


Figure 39. Historical and Projected Population Served for Whitman



6.0 Alternate Future Scenario Planning

Alternate projections were developed from the baseline projection to account for various future scenarios. These scenarios evaluate uncertainties regarding future conditions of variables that influence water demands to further guide the water resource planning process. The alternate scenarios developed for this analysis, shown in **Table 11**, incorporate different levels of population growth, climate variability, different rates of water use efficiency, changes in unaccounted for water (UAW) over historical average, and private well users switching to a public water system (PWS).

Table 11. Alternate Future Scenario Parameters for OCPC Regional Water Plan

Planning Scenario	Population Growth	Future Climate Variability	Water Use Efficiency (Passive Conservation)	Trend in UAW	Private Wells to Public Supply
Baseline	Expected	Historical Average	Average increase in efficiency (current codes)	Constant	None
Low Stress	Expected	Cool/Wet	Greater than average increase in efficiency (high efficiency)	Decrease	None
Significant Stress	10% greater than expected	Hot/Dry	Less than average increase in efficiency (slower rate of meeting current codes)	Increase	100%
Significant Stress with Mitigation	10% greater than expected	Hot/Dry	Greater than average increase in efficiency (high efficiency)	Decrease	100%

The population projections used in the baseline demand projection were adjusted 10 percent for the significant stress future scenarios to account for uncertainty regarding future population. The population projections from UMass have population increasing through 2035, then decreasing slightly through 2050. Therefore, the significant stress future scenarios make use of the same pattern, with projected population in 2035 and 2050 adjusted by 10 percent and linearly interpolating the projected population for years in between.

Future climate variability is based on global climate models (GCMs) from the Coupled Model Intercomparison Project Phase 5 (CIMP5) for the same weather stations used in analysis of historical weather (Blue Hill, Plymouth, and Taunton). Data for the 10th and 90th percentiles were used for precipitation and max temperature to capture the range of possible climate futures. Under the low stress scenario, which uses a cool/wet climate future, total precipitation increases 57.5 percent while max temperature decreases 2 percent. Under the significant stress scenarios, which use a hot/dry climate future, total precipitation decreases 57.1 percent and max temperature increases 12.9 percent.

Changes in water use efficiency over time were adjusted to account for a slower than expected rate of efficiency improvements (significant stress) and for the possibility of increased efficiency over current efficiency standards (low stress and significant stress with mitigation). The potential slower rate of efficiency improvements was based on a slower rate of replacement to reach current efficiency standards which results in a 3.2 percent increase in per capita water use over the baseline projection. Conversely, the future scenario with increased efficiency based on fixtures and appliances already available on the market more efficient than required by current efficiency standards, results in 12.7 percent lower per capita water use than the baseline projection.

The trend in UAW was also adjusted as part of the future scenarios. The historical average volume of UAW (1,541 MGY) was adjusted ±10 percent by 2050 to account for possible reductions in water loss (low stress and significant stress with mitigation) and for water loss increasing over time due to distribution systems leaking more with age (significant stress). The values for UAW were linearly interpolated from the historical average volume at the start of the planning horizon to the adjusted UAW volume in 2050. The low stress and significant stress with mitigation scenarios assume total volume of UAW decreases to 1,387 MGY in 2050 and the significant stress scenario assumes UAW increases to 1,696 MGY in 2050.

Households with private wells providing their potable water may decide to switch the source of their supply to a PWS due to water quality concerns or other supply issues. Therefore, the significant stress scenarios include additional population served for these private well users. Available data for number of private well users indicate approximately 9,600 private wells in the planning area. Census data was acquired for number of persons per household by community and multiplied by the number of private well in each community to estimate the increase in population served from private wells switching to PWS supply. The result is approximately 25,000 additional residents to be served by the PWSs in the OCPC planning area. This analysis assumes half the private well users would be served by a PWS by 2035 and all would be served by a PWS by 2050.

The results of the various future scenarios, shown in **Figure 40**, provide a range of possible future demands across the planning horizon. Projected demand decreases across the planning horizon under all future scenarios due to efficiency improvements over time, which has a significant impact on overall water use for the OCPC planning area, despite scenarios with significant population growth and climate variability.

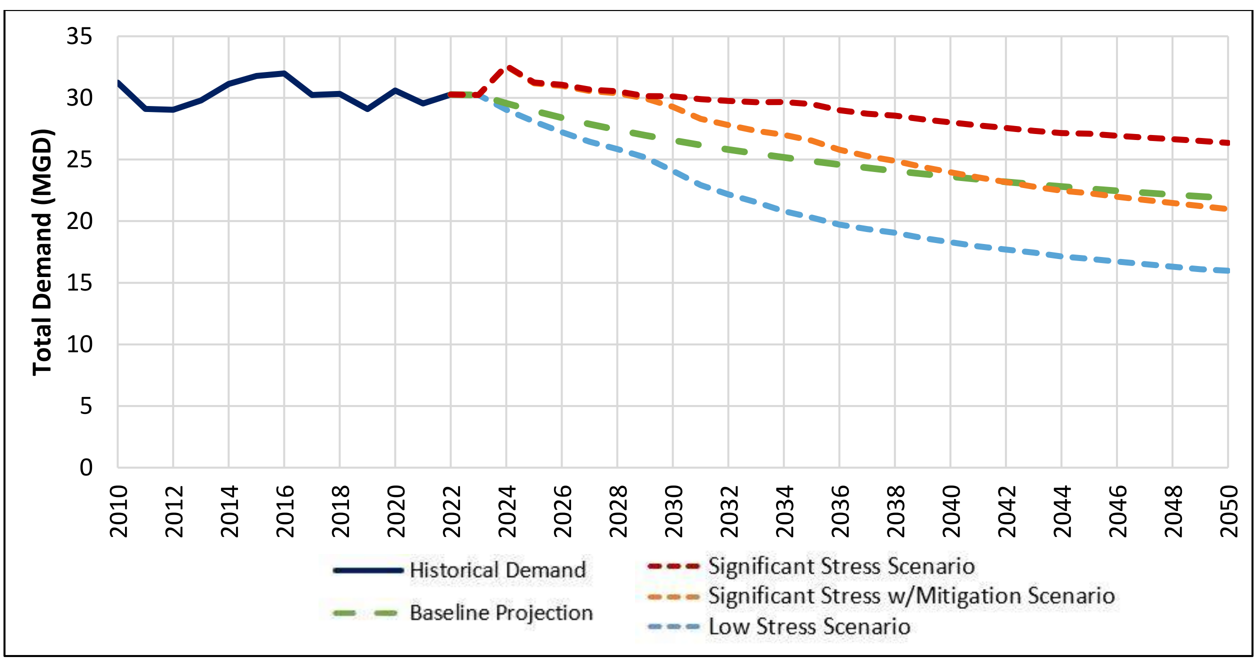


Figure 40. Projected Demand for OCPC Planning Area Under Various Future Scenarios

The outcome from the future scenarios is as follows:

- Significant stress scenario – results in demands approximately 4.5 MGD higher than the baseline demand projection in 2050, an increase of 20 percent. Projected demands decrease slightly across the planning horizon as improvements in efficiency lower per capita demand. The impact of climate variability is more than offset by efficiency improvements from passive conservation.

- Significant stress with mitigation scenario – has higher projected demands than the baseline projection until 2042, then greater improvements in efficiency begin to result in lower projected demand than the baseline projection. Ultimately, demands in the significant stress with mitigation scenario are projected to be 4 percent lower than the baseline projection by 2050 due to reductions in per capita demand and UAW.

- Low stress scenario – has demands below the baseline projection across the planning horizon. The projected demand in 2050 for the low stress scenario is approximately 27 percent lower than the baseline projection due to a cool/wet climate future, significant improvements in efficiency, and reduced UAW.

The results of the future scenarios illustrate the significant impact of increased water use efficiency over time. Total demands are projected to decrease across the planning horizon due to reductions in per capita water use, which is projected to decrease approximately 23 percent by 2050. Real world water use data[8] from a water use analytics firm (Flume Data Labs) indicates the average per capita rate for indoor usage in the greater Boston metro area is approximately 34 GPCD. Available best technology for fixtures and appliances could realistically result in indoor demand of 30 GPCD. Analysis of data from OCPC communities and MassDEP indicates the per capita indoor use rate for the OCPC planning area is approximately 46 GPCD. Therefore, there is significant potential for further reduction in per capita use in the OCPC planning area as end use efficiency improves over time due to impact of efficiency standards (i.e. passive conservation) and customer adoption of fixtures and appliances even more efficient that current state standards.

Another notable finding from the future scenarios is the impact of climate variability on water demand. While the significant stress scenarios use a hot/dry climate future in calculation of projected demands, the overall impact from climate variability is muted by increases in efficiency. While the average max temperature in the hot/dry climate future is 12.9 percent higher than the historical average max temperature, that only equates to 3.2 percent increase in demand. Projected total precipitation in the hot/dry climate future decreases 57.1 percent from historical average for total precipitation but that only equates to a 5.7 percent increase in demand. Furthermore, the projected decrease in precipitation in the hot/dry climate future still results in total monthly precipitation greater than one inch in all future months, which indicates that outdoor water demands would likely not change drastically in response to greater irrigation demand, as minimal supplemental irrigation would be required to sustain most turf grass and landscaping.

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[8] https://flumewater.com/water-index/

Appendix D Alliance for Water Efficiency Memorandum on Recommendations for Water Efficiency

DATE: July 29, 2024

TO: CDM Smith OCPC Regional Water Plan Team

FROM: Andrew D. Morris, Senior Manager of Policy and Programs, AWE
Liesel Hans, PhD, Director of Programs, AWE

SUBJECT: **Alliance for Water Efficiency Memorandum on Recommendations for Water Efficiency in the Old Colony Planning Council Region**

Executive Summary

CDM Smith hired the Alliance for Water Efficiency (AWE) as a subconsultant to help develop the Old Colony Planning Council (OCPC) regional water plan. AWE focused on reviewing, analyzing, and making recommendations for water efficiency in the OCPC region. The results of AWE's efforts are summarized in this memorandum to CDM Smith. AWE understands that CDM Smith will consult with the Steering Committee and OCPC regarding these recommendations, and there will be a section of the regional water plan that summarizes which of these recommendations are included as demand-side alternatives for consideration in the final plan.

AWE has developed a set of high-priority recommendations for additional, active efficiency that will lower long-term demands. These were developed based on their potential to save water, as well as the multiple other benefits to utilities, such as better data collection and decision-making, improved operations, and better customer service. While the region is not projected to have significant supply gaps, water efficiency has multiple benefits to utilities, customers, the broader community, and the environment. And even when supplies appear to be adequate when looking at the average day over a year, increasing temperatures and drier conditions in the summer can lead to peak demands that stress systems' operational capacity.

These high-priority recommendations have the potential to save significant amounts of water, as outlined in the following sections. If these recommendations were to be implemented through well-funded, carefully designed, and aggressively implemented efforts, savings could reach the amounts shown for the region as shown in **Table ES-1** measured on an average annual day basis in millions of gallons per day.

Table ES-1. High priority recommendations for water conservation for OCPC public water utilities

High-Priority Recommendations (See Section 2 for Details)	High-End Estimate of Regional Water Savings (Million Gallons per Day)
2.1 – Conduct, Validate, and Act on Annual AWWA Water Loss Audits	1.0
2.3.1 – Customer-Side Leak Detection Program (Customer-Facing AMI Portal; 50% Enrollment)	1.5
2.3.2 – Customer-Side Leak Detection Program (Advanced Metering Infrastructure (AMI)-Enabled and Proactive)	0.3
2.4 – Improve Increasing Block Rate Designs	3.0
Total	5.8

Utilities should consider the benefits and costs of each item based on their unique and circumstances. Given that costs are heterogenous, only some basic cost information has been provided in this memorandum. Nonetheless, the high-priority recommendations were selected because the water savings and the full range of benefits are likely to exceed the costs based on AWE's experience. In terms of benefits, the most basic benefit is the avoided variable production cost of water. For utilities that prepare the AWWA water loss audits, the variable production cost developed as part of those audits can be used to estimate the water-treatment-and-distribution-related operational savings from additional water efficiency.

Passive efficiency is analyzed in detail in Appendix A, and the bottom line is that significant additional per capita water use reductions are expected over time based on both federal efficiency requirements for residential appliances and an efficiency law that recently took effect in Massachusetts. Passive water efficiency measures do not require users to change behavior or otherwise require action by utilities or the regional or local governments in the OCPC region.

Massachusetts recently took action to require that only high-efficiency products be sold in the state. In the Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy (Bill S.9 (192nd 2021-2022)), Massachusetts established new requirements for water-efficient fixtures relevant to residential water use, as shown in **Table ES-2**. These requirements became effective on January 1, 2023.

Table ES-2. Massachusetts requirements for water-efficient fixtures for residential water use

Plumbing Fixture	Federal Minimum Requirement	New 2023 MA Requirement
Bathroom faucet	2.2 gpm	1.5 gpm
Kitchen faucet	2.2 gpm	1.8 gpm
Showerheads	2.5 gpm	2.0 gpm
Toilets	1.6 gpf	1.28 gpf

gpm = gallons per minute; gpf = gallons per flush

In addition to water-efficient plumbing fixtures focused on indoor water use, this new law in Massachusetts also requires WaterSense-labeled spray sprinkler bodies, which help regulate pressure and save water in landscape irrigation systems. To continue down this path towards greater outdoor efficiency in the future, AWE recommends that this Massachusetts law be amended to also require WaterSense-labeled irrigation controllers. According to the Appliance Standards Awareness Project's 2024 savings report, requiring WaterSense irrigation controllers could save 1,212 million gallons per year in Massachusetts by 2040.[1] Colorado and Nevada both require WaterSense irrigation controllers, and more states are expected to do so in the near future.

The water savings from passive water efficiency and how it affects CDM Smith's demand projections are addressed in Appendix A of this memorandum. Given that the OCPC region's population is projected to grow slowly and then remain relatively stable, passive efficiency has a big impact over time on water demands.

AWE offers additional recommendations for consideration related to new and redevelopment, efficiency and affordability, and drought preparation and response. These additional recommendations save

[1] appliance-standards.org/sites/default/files/2024_Massachusetts_Appliance_Standards_Savings_Report.pdf

somewhat less water compared to the high-priority recommendations, and some apply only in certain circumstances, such as during a drought. Of these additional recommendations, utilities should pay special attention to the WaterSense homes program (Section 3.6), water bill leak adjustment programs (Section 4.2), and local public water supply drought management plan (Section 5.1). Also, for communities served by the Massachusetts Bay Transportation Authority that may be required to accommodate more growth based on the multifamily zoning requirements, all the recommendations for new and redevelopment are worthy of consideration. A comprehensive list of AWE's recommendations is provided in **Table ES-3.**

Table ES-3 AWE's recommendations for water efficiency and drought management

	Responsible Party
Section 2 – High-Priority Recommendations for Long-Term Demand Reductions	
2.1 – Conduct, Validate, and Act on Annual AWWA Water Loss Audits	Utility
– Change requirement from unaccounted-for water to AWWA water loss audits	State
– Apply for state funding for water loss audits	Utilities; OCPC
2.2 – Adopt AMI and Monthly Billing	Utility
2.3 – Implement Customer-Side Leak Detection Program	Utility
– Customer-Facing AMI Portal	Utility
– AMI-Enabled Proactive Leak Notification Programs	Utility
– Rebates for Leak Detection Devices	Utility
2.4 – Improve Increasing Block Rate Designs	Utility
2.5 – Review and consider AWWA G480-20 Standard for Water Conservation and Efficiency	Utility
Section 3 - Recommendations for New and Redevelopment	
3.1 – Recognize Use of Water Demand Calculator through the Plumbing Code	State
3.2 – Use the AWWA M22 Manual for Sizing Water Service Lines and Meters	Utility
3.3 – Monitor and Update State Point of Sale Requirements for Water-Efficient Products	State
3.4 – Consider Adopting Local Irrigation System Efficiency Requirements	Utility; Town Council
3.5 – Consider Water Use in Land Use Planning Efforts	Town Council; OCPC
3.6 – Consider WaterSense-Labeled Homes Program	Utility; Town Council
Section 4 - Recommendations for Efficiency and Affordability	
4.1 – Partner with Efficiency and Housing Groups	OCPC
4.2 – Implement water bill leak adjustment program	Utility
4.3 – Education and conservation kits	Utility
Section 5 - Recommendations for Drought Preparation and Response	
5.1 – Develop local public water supply drought management plan	Utility
5.2 – Focus drought education and response on largest irrigators	Utility
5.3 – Adopt local bylaws for enforcement of drought restrictions	Utility
5.4 – Collaborate regionally on drought planning and messaging	OCPC

Several recommendations would require engagement and action by utilities, town councils, OCPC, and the state to be impactful on a large scale. Collaboration may be especially necessary when trying to address low flows in surface waters and low levels in groundwater resources that are shared by multiple communities. To realize environmental benefits for shared resources, collective action is likely required. In watersheds or groundwater basins of concern, communities could:

- Commit to take action and seek to meet conservation targets on a voluntary basis
- Enter into more formal agreements to be bound to such goals
- Establish requirements and goals with enforcement through permits

1.0 Methodology

In terms of its process and analyses, AWE has taken the following steps:

- Reviewed the annotated bibliography CDM Smith prepared
- Reviewed water data from OCPC communities
- Reviewed state laws, plans, and standards
- Reviewed water rates and structures from OCPC communities
- Reviewed several OCPC regional plans on transportation and other regional issues
- Compared regional efforts to other regions in the eastern United States and beyond
- Compared regional efforts to American Water Works Association (AWWA) G480-20 Standard for Water Conservation and Efficiency Program Operation and Management
- Attended and presented in-person at an OCPC Regional Water Plan steering committee meeting in Brockton, MA, on May 20, 2024; received verbal and written feedback and notes from the small group discussion
- Reviewed and provided feedback to CDM Smith regarding water demand projections related to ongoing passive water efficiency.

At the OCPC Regional Water Plan steering committee meeting on May 20, 2024, AWE learned that each community in the region is at a different implementation stage regarding the types of actions outlined in this report. AWE recognizes that some communities may have already implemented some of these recommendations. Based on the feedback received from stakeholders, AWE has further refined its analyses and recommendations for the region.

Concurrently with AWE's review and work developing water efficiency recommendations, CDM Smith has been developing a range of demand projections. AWE has reviewed and provided feedback on these demand projections, and they reasonably reflect the expected changes in demand due to passive efficiency. Passive water efficiency are measures that do not require users to change their behavior. For this memorandum, the focus on passive efficiency is also limited to water efficiency measures that do not require significant additional action by utilities or the regional or local governments in the OCPC region. AWE encourages utilities to embrace these demand projections and the downward trajectory in both *per-person use* in all communities and *overall water use* declines in most communities. This will allow utilities to defer or altogether avoid some additional costs and environmental impacts of developing new water supplies and related water treatment and infrastructure capacity. Appendix A of this memorandum contains more details about passive efficiency and how it affects the demand projections for the OCPC region.

2.0 Recommendations for Long-Term Demand Reductions

2.1 Conduct, Validate, and Act on Annual AWWA Loss Audits

According to the AWWA, water loss can be understood as the difference between water supplied to a utility's distribution system and authorized consumption. Water losses are made up of apparent losses (e.g., systematic data-handling errors, customer-metering inaccuracies, unauthorized consumption) and real losses (e.g., physical water losses from the utility's water mains, storage tanks, and other parts of the distribution system). This memorandum is focused on real losses because reducing the physical volumes of water lost from the utility's system can serve as an alternative to new water supplies, treatment, and related infrastructure.

Currently, Massachusetts requires public water suppliers to calculate unaccounted-for water (UAW) as part of the annual statistical report that they submit to the MassDEP. This requirement in Massachusetts puts it ahead of many states that do not have any water-loss-related requirements based on the Alliance for Water Efficiency's (AWE's) 2022 U.S. State Policy Scorecard for Water Efficiency and Sustainability.[2] However, Massachusetts' approach to UAW has several shortcomings, both at the conceptual level and as applied to utilities in the OCPC region.

At a conceptual level, there are challenges associated with using UAW and percentages; as a result, AWWA discourages use of the term UAW and the use of percentages. AWWA compiled a document that addresses these challenges titled "Water Loss Control Terms Defined: Why the terms 'unaccounted-for' water and 'unaccounted-for percentage' just don't work!"[3] AWWA noted that "[w]hile the term "unaccounted-for" water appears to be self-explanatory, it suffers from inconsistent use and interpretation." Based on AWE's high-level analysis, this appears to be the case in Massachusetts. MassDEP's instructions for calculating UAW are found in the 2024 version of the *Massachusetts Department of Environmental Protection Drinking Water Program Instructions for the Annual Statistical Report (ASR)*.[4] **Figure 2-1** shows an example equation for calculating UAW for the ASR.

Table DS-5 Unaccounted for Water To calculate UAW, subtract total metered use and confidently estimated municipal use volumes from the total volume of finished water entering your distribution system.

	Million Gallons/Year (MGY)	% of Total Water Available for Distribution
Total Finished Water Available for Distribution **(Total Net Finished Water from Production Form)**	390	100%
Total Metered Use **(System Total Metered Use from Table DS-3)**	- 365	- 93.6 %
Total Confidently Estimated Municipal Use **(Total from Table DS-4)**	- 7.57	- 1.9 %
Unaccounted for Water (UAW)	= 17.4	= 4.5 %

ReCalculate Total

Enter the "Total Net Finished Water", in million gallons per year, from the Water Production and Consumption form. The Total Metered Use comes from Table DS-3 and the Total CEMU comes from Table DS-4. The percentages and totals will be calculated automatically when the "**Calculate Total**" button is clicked. If you make any changes you must click on the "**Recalculate Total**" button.

Figure 2-1 Massachusetts Department of Environmental Protection's Instructions for Calculating UAW

Confidently Estimated Municipal Use (CEMU) is subject to several challenges. First, the components of CEMU are not well defined. Second, it relies heavily on estimates rather than metered data. Third, it

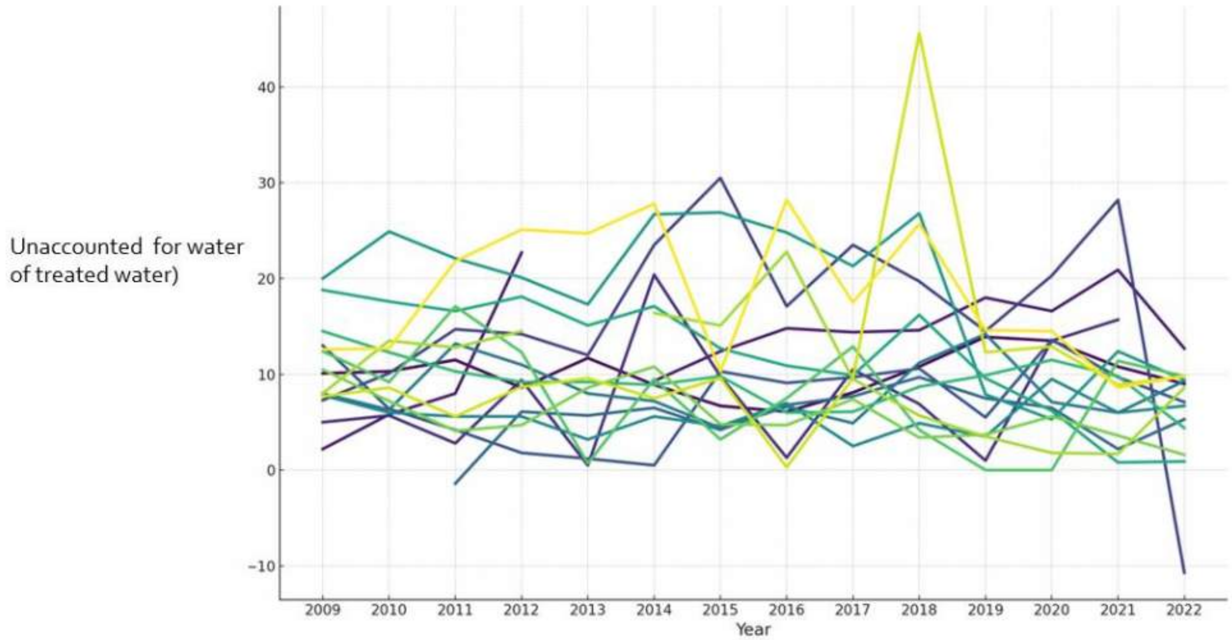
[2] Available at www.allianceforwaterefficiency.org/2022Scorecard.
[3] Available at https://www.awwa.org/Portals/0/AWWA/ETS/Resources/WLCwater-loss-control-terms-defined-awwa-updated.pdf?ver=2014-12-30-084848-790
[4] Available at https://www.mass.gov/how-to/public-water-supply-annual-statistical-reporting-via-edep

allows utilities to exclude some major water main breaks, which effectively masks the impacts of these significant sources of real water loss.

With respect to using percentage indicators, AWWA highlighted (in this same document) that:

- This type of performance indicator is mathematically skewed because it is unduly affected by varying levels of customer consumption[5]
- It is impossible to reliably represent multiple types of non-revenue water typically occurring in a water utility with a single simplistic percentage
- Simple percentage reveals nothing about water volumes and costs, the two most important factors in water loss assessments of water utilities

Furthermore, looking at how UAW is defined and calculated in Massachusetts, there is another major conceptual gap. The issue stems from the fact that the UAW treats all losses the same and does not provide an easy way to understand and distinguish between apparent losses and real losses. As mentioned above, apparent losses consist of items like systematic data-handling errors, customer-metering inaccuracies, and unauthorized consumption; real losses consist of physical water losses from the utility's water mains, storage tanks, and other parts of the distribution system. Both types of losses are important for utility management; for the purpose of conservation, one needs to know how much of the UAW is real losses. Based on these challenges, AWE recommends that the state switch from the UAW methodology to using the AWWA water audit method and the performance indicators used in it. When looking at how the UAW concept as measured and reported by utilities in the OCPC region, one can readily observe that the data are noisy and inconsistent. **Figure 2-2** shows the UAW percentages reported to MassDEP by utilities in the OCPC region.



[5] For example, in a very dry year when outdoor irrigation and total demands are high, UAW expressed as a percentage will be lower compared to a wet and cool year when irrigation and total demands are low even though the absolute amounts of water loss change very little based on temperature and rainfall.

Figure 2-2. Unaccounted-for water by community (anonymized) in the OCPC region from 2009–2022

The names of the utilities have been removed because the focus here is on the challenge with UAW and UAW percentages and on data collection and quality in general. For many utilities this chart shows very large fluctuations from year to year, missing data, and negative percentages, which are not physically possible. This demonstrates many of the problems with the UAW approach that AWWA has highlighted as applicable to the OCPC region. These results are likely due to factors such as inherent challenges with the UAW percentage approach, differences of interpretation and application by staff across utilities (and by new staff members when there is transition), and by underlying data management and data quality issues. These types of issues are common and exist despite the good faith efforts of utility staff; a better methodology and continuous training is necessary to help guide utilities down a better path.

Based on the above, AWE recommends that, in addition to completing the required UAW approach, all utilities in the OCPC region take the following actions each year:

- Conduct water loss audit using AWWA M36 methodology and free water loss audit software
- Validate water loss audits using a third party with relevant training and experience
- Act on the results by improving data validity score and reducing real losses

More information about the AWWA water audit method and related documents, reports, and tools can be found at https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control.
The State of Massachusetts regularly has funding available to facilitate this work involved with conducting and validating a water loss audit. Information can be found on the state website under the M36 Water Audit Opportunity grant section – www.mass.gov/info-details/water-management-act-grant-programs-for-public-water-suppliers#m36-water-audit-opportunity. AWE recommends that OCPC and all interested utilities collaborate to apply for this funding and host regional meetings for utilities to receive training and technical assistance as a group. Also, because water audits account for water that may be imported or exported between neighboring utilities, collaboration is likely to have additional benefits.

In light of the apparent data quality in the UAW numbers in the OCPC region, AWE recommends focusing on the data validity grade score and taking any necessary actions to achieve at least Tier IV (71 to 90). The data validity grades reflect how the data are measured, collected, and handled, and the AWWA free water loss audit software makes recommendations based on utility inputs to improve data validity. These recommendations can include activities such as calibrating and flow accuracy testing of production meters and import/export meters, testing customer meters, and improving data collection and handling processes.

After conducting audits and improving data validity scores, a utility can consider other key performance metrics, goal setting, and water loss control planning. A common key performance metric for real water losses is measuring losses in terms of gallons per connection per day. More information pertaining to key performance metrics can be found in the AWWA report titled *Performance Indicators for Non-Revenue Water AWWA Water Loss Control Committee Report November 2019*. Based on the study of data from California, Georgia, Tennessee, and Texas, the median utility can cost-effectively reduce their real water losses by more than one-third.[6] Assuming that the UAW reporting in 2021 in the OCPC region is made up of 80% real losses, then a one-third reduction for the region (as a whole) would result in

[6] Amanda Rupiper et al. 2022. *Environ. Res. Lett.* **17** 034021

water savings of approximately 1 million gallons per day. However, the cost-effective real loss reductions will vary significantly from utility to utility.

2.2 Adopt Advanced Metering Infrastructure and Monthly Billing

AMI for water utilities is a comprehensive system that enables the automated collection, transmission, and analysis of water usage data from smart meters installed at customer locations. This technology allows utilities to gather detailed hourly data about water consumption, thereby providing a granular view of usage patterns and trends. With AMI, utilities can monitor water usage in near real-time, identify leaks or unusual consumption, and optimize water distribution and resource management. This continuous flow of data offers valuable insights, enabling utilities to improve operational efficiency, enhance customer service, and support water conservation and water loss management efforts by identifying and addressing issues swiftly and accurately. It also helps automate the billing processes and reduces the labor requirements for meter reading. AWE recommends that utilities consider AMI when the need for significant meter replacements arises. For more information about AMI, utilities can sign up for AWE's free Conservation and AMI working group by contacting office@a4we.org. Also, in February 2022, AWWA published a guidebook titled *Increasing Consumer Benefits and Engagement in AMI-Based Conservation Programs* that contains a wealth of useful information.

Switching from semimonthly, quarterly, or semiannual billing to monthly billing provides significant benefits to water utilities and their customers by offering more timely information about water usage. Monthly billing cycles allow customers to receive more frequent updates about their water consumption, making it easier for them to monitor and manage their usage patterns. This increased billing frequency helps customers detect and address potential leaks or unusual spikes in water usage more promptly, thus preventing waste and reducing costs. Additionally, more frequent billing enhances customer engagement and satisfaction because they can better understand and respond to their water usage habits. For utilities, this shift improves cash flow, reduces the risk of large outstanding balances, and facilitates better resource planning and management.

Because of its many benefits, monthly billing is (by far) the most common practice throughout the United States. This is the case where water is scarce and where water may be somewhat more plentiful. Consider North Carolina, for example, where monthly billing was the most common approach even 15 years ago, and monthly billing has become increasingly common over time. **Figure 2-3** shows a graph of the data from an article published on the University of North Carolina Environmental Finance Blog:

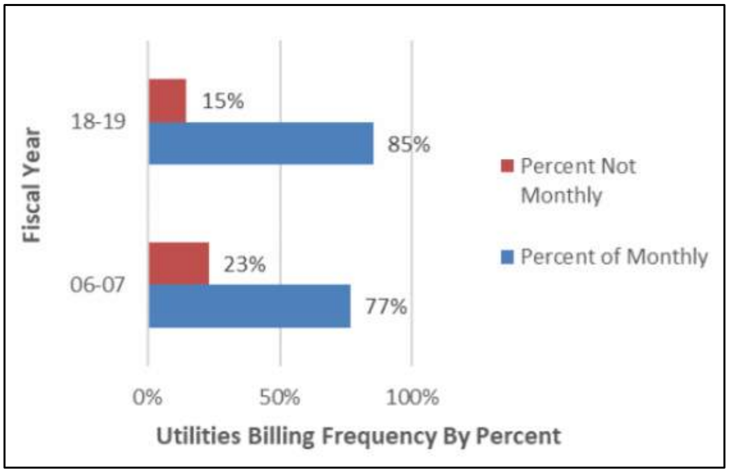


Figure 2-3. Change in Billing Frequencies of North Carolina Water Utilities

AWE recommends that all utilities in the OCPC region switch to monthly billing as soon as possible. While it is expected that switching from quarterly billing (or other more infrequent billing) to monthly billing may result in reduced consumption, the changes are typically small and so have been excluded from this analysis. AMI metering and monthly billing are best practices, and the main water efficiency benefit is that they are necessary building blocks for improved water loss auditing, customer-side leak detection, and improved inclining block rates.

2.3 Implement Customer-Side Leak Detection Program

Customer-side leaks refer to unintended consumption on the customer's side of the meter. This includes things like a leaky service line or irrigation system in a customer's yard, a running toilet or faucet, a pool or spa fill line that gets left in the on position, and leaks from pipes inside a customer's home. Based on the leading study of indoor water usage in homes, customer-side leaks account for 7.9 gallons per capita day, which represents 14% of total residential indoor water use.[7] Leaks in the OCPC region are likely higher, given that the average home in that area is older than the average home in the United States. Adopting AMI, as recommended above, enables the following two main types of programs intended to reduce customer-side leaks—(1) customer-facing AMI portal and (2) AMI-enabled proactive leak notification.

2.3.1 Customer-Facing AMI Portal

Utilities can offer and promote a web- and smartphone-based portal that provides access to water use data. These portals are offered by metering companies and by stand-alone customer portal companies and provide a range of features. Many portals have built in analytics tools and communications centers, and they can help send broad or targeted messages quickly and easily. Many can also integrate and improve online bill pay too - increasing the reliability of payment each billing cycle. One of the most common features allows customers to receive notifications about potential customer-side leaks. Different portals use different names for both the concept and the alerts (e.g., may be referred to as constant consumption, irregular use, suspected leak). The demand reductions per enrolled customer range from 2% to 10%[8]; however, given that savings are only realized when customers enroll, utilities

[7] See Figure ES.4 in Residential End Uses of Water Version 2, 2016 (Water Research Foundation Project No. 4309)
[8] "Increasing consumer benefits & engagement in AMI-based conservation programs" January 2022; report prepared for AWWA.

must focus and spend resources on promoting enrollment. Water utilities can promote enrollment in customer portals through marketing campaigns, website promotion, customer service outreach, incentives, and educational materials. They can emphasize user-friendly design, mobile access, and additional services such as online bill pay to enhance customer engagement and satisfaction.

2.3.2 AMI-Enabled Proactive Leak Notification Programs

In these AMI-enabled proactive programs, the utility creates a leak notification program where it notifies customers about constant consumption. These programs do not depend on customers enrolling in a portal because the utility uses the AMI data available on its end to send these notices directly to customers, typically by email or text message. The most effective programs involve automated notices. For more information regarding these programs, see AWE's March 2023 *Smart Practices to Save Water: An Evaluation of AMI-Enable Proactive Leak Notification Programs* report. The potential demand reductions from these programs can be as much as 1% of overall single-family water use for well-designed programs. These AMI-enable leak notification programs can also be paired with leak adjustment policies as discussed below in Section 5.2.

2.3.3 Rebates for Leak Detection Devices

For utilities that do not have AMI or that want to provide an additional option for customers interested in reducing customer-side leaks, there are behind-the-meter technologies that can measure water use and detect potential leaks. Utilities can promote these products by offering rebates or negotiated discounts with product sellers. While utilities should investigate the full range of alternatives, there are several leading product types. First, there are products that strap onto the customer's water pipes and measure flow. Droplet by Hydrific is one such product. Second, there are products that attach to the utility's water meter and provide data directly to consumers. Flume is one such product. Third, there are products that are installed in-line with the customer's plumbing that both measure water use and have the capability of shutting off the water when a leak is detected. Flo by Moen is one such product. Demand reductions within a household that begins using these products have been documented in the range of 10%. AWE recommends that utilities in the OCPC region with no plans to implement AMI consider rebates for leak detection devices to promote awareness and adoption among their customers.

2.4 Improve Increasing Block Rate Designs

Increasing block rate design is a pricing structure used by water utilities where the cost per unit of water increases with higher levels of consumption. This rate structure is designed to encourage water conservation by making it increasingly more expensive on a unit basis to use water as overall usage increases, thus providing a financial incentive for consumers to reduce usage. **Table 2-1** shows an example from the OCPC region.

Table 2-1. Water Rate per Thousand Gallons, Current Rates Effective January 1, 2024

	Quarterly	2023 Per Thousand Gallons	*2024 Per Thousand Gallons*
1st Step	0 -20,000 gals	$5.03	*$5.44*
2nd Step	20,001-50,000 gals	$6.12	*$6.61*
3rd Step	Over 50,000 gals	$7.65	*$8.26*

The benefits of this rate design include promoting sustainable water use, ensuring equitable pricing by charging higher rates to those who use more, and generating additional revenue that can be reinvested in infrastructure and conservation programs. Well-designed increasing block rate structures ensure the costs of serving peak customers are allocated to peak customers, which better reflects cost of service, promotes conservation, and improves relative affordability for customers with only basic indoor use.

Utilities in the OCPC already use increasing block rates, as required by their state permits, and typically use three blocks; however, because utilities bill bimonthly, quarterly, and even biannually, customers with significantly different use profiles are ultimately charged the same amount. **Figure 2-4** shows two hypothetical examples where both households use 23,000 gallons over a 3-month period

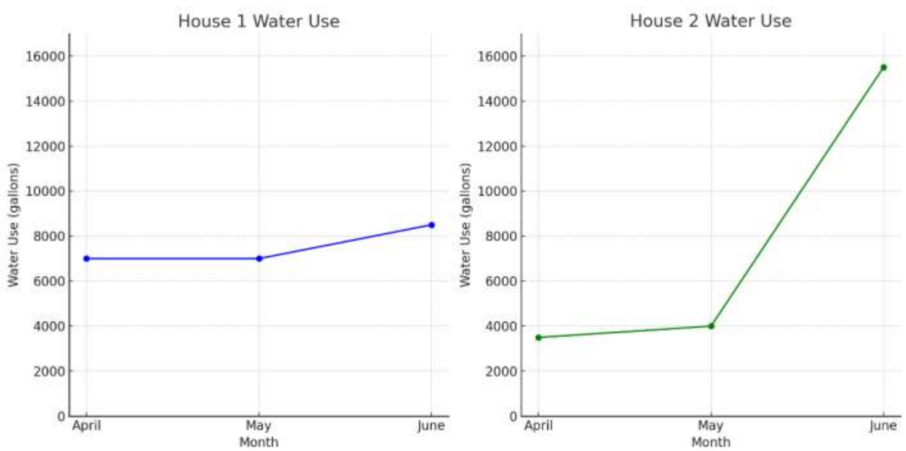


Figure 2-4. Two Households: Same Quarterly Volumetric Use, Different Peak Profiles

House 1 could be a larger family or a household that uses a water softener or reverse osmosis filtration system, such that their average monthly use is relatively high. House 2 could be a couple that likes to irrigate their lawn, which results in low levels of usage in colder months and increasing usage as the temperature rises. In this example the cost of serving House 2 is much higher because that household contributes far more to peak water demands and the expensive infrastructure needed to serve these peaks. Yet, because this utility bills quarterly, both households would be billed the same amount.

Consistent with AWE's recommendation (mentioned above) regarding monthly billing, AWE recommends reworking increasing block rates based on monthly billing to better reflect the cost of serving customers that drive peak demands. While it may not be the primary purpose, these changes are also likely to benefit low- and moderate-income customers because they typically use low volumes of water. Keeping the rates for the first block relatively low will improve affordability for these customers, as justified by the low cost of service for basic service volumes.

After reviewing the increasing block rate structures used in the OCPC region, AWE also recommends resizing and restructuring the blocks and considering a fourth block to better reflect key usage thresholds and to ensure meaningful price differentials between the blocks. The size and number of blocks should be based on a utility-specific review of customers and the range of demand profiles. Consider the following illustrative example:

Block 1: Basic Household Use – 0 to 4,000 gallons

Block 2: Efficient Irrigation – 4,001 to 8,000 gallons (assumes one irrigation cycle per week at ~1,000 gallons per cycle)

Block 3: Frequent Irrigation – 8,001 to 20,000 gallons (assumes two to three irrigation cycles per week)

Block 4: Excessive Irrigation – 20,001 gallons plus

The demand reductions from increasing block rate structures will vary. Poorly designed structures will not reduce demands. Well-designed structures can reduce demands by 10% or more and still increase overall revenue.[9] This is achieved by recognizing that increasing rates tend to decrease demands; therefore, rate increases should be sized and structured to offset expected decreases in demand. It is more expensive to serve customers with high peaks in their demands, and consistent with cost of service and ratemaking principles, rates for these customers can be increased to offset overall declines in demands. The revenue and demand impacts of a given rate structure can be estimated as part of a rate study that accounts for price elasticity and strength of the conservation signal.

AWE recommends hiring a rate consultant to help with the switch to monthly billing and to redesign the increasing block rate structures. For something as critical to utilities as their rates, experienced rate consultants are very valuable and should be used whenever possible. AWE understands that Massachusetts offers grants to hire rate consultants to help with rate redesigns. Information can be found on their website under the Statewide Water Management Act Grant section.[10] This grant covers 80% of the costs of rate studies that help control demand. Depending on utility size and rate design complexity, the typical cost to hire a rate consultant for small and medium size utilities ranges from $30,000 to $100,000.

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[9]OCPC communities should work with an experienced rate consultant to come up with community-specific estimates of water savings. 10% was selected as a regional estimate by AWE based on its review of the literature and assuming high-quality, conservation-oriented rate designs are implemented. A range of outcomes are possible. For example, one study that examined inclining block rate structures in detail found a savings of 17%. See Baerenklau, Kenneth & Schwabe, Kurt & Dinar, Ariel. (2014). The Residential Water Demand Effect of Increasing Block Rate Water Budgets. Land Economics. A more recent, larger study from California that looked at demand decreases without evaluating the quality of the rate design found an average demand reduction of 2.6%. See "The impact of pricing structure change on residential water consumption: A long-term analysis of water utilities in California. Juhee Lee, Mehdi Nemati, Maura Allaire, Ariel Dinar, "The impact of pricing structure change on residential water consumption: A long-term analysis of water utilities in California" Water Resources and Economics, Volume 46, 2024.

[10] See www.mass.gov/info-details/water-management-act-grant-programs-for-public-water-suppliers#statewide-water-management-act-grant-

There are a wide range of resources available to help with this process, including a number of free tools from the AWE.[11] Consider the following resources:

- AWWA M1 Principles of Water Rates, Fees, and Charges
- AWE *Guidebook on Building Better Water Rates for an Uncertain World*
- AWE Sales Forecasting and Rate Model
- Designing Water Rate Structures for Conservation and Revenue Stability, UNC Environmental Finance Center and the Sierra Club

2.5 Review and Consider AWWA G480-20 Standard for Water Conservation and Efficiency Program Operation and Management Standard

For utilities seeking additional information about water conservation practices, AWE recommends they review the AWWA G480 Standard. A utility might consider implementing some or all of the AWWA G480 Standard to enhance its water conservation and efficiency efforts. The G480 Standard provides a structured framework for implementing and evaluating water conservation programs, and it consists of a comprehensive suite of practices ranging from metering and billing to water loss, to planning, to policies for new development, to customer facing programs and communications. By adhering to this standard, utilities can ensure they are employing best practices and achieving measurable outcomes in water efficiency. This can lead to significant operational benefits, such as reduced water loss, lower energy costs, and improved system reliability. Furthermore, demonstrating compliance with the G480 Standard can enhance a utility's reputation and credibility, showing a commitment to sustainable resource management and environmental stewardship. Ultimately, this can foster greater trust and engagement from customers and stakeholders, supporting long-term conservation goals and regulatory compliance.

3.0 Recommendations for New and Redevelopment

For communities in the OCPC region that expect meaningful amounts of new development, redevelopment, and major renovations of homes, additional water efficiency efforts are worth considering. This may be especially relevant to MBTA communities that may accommodate more growth based on the multifamily zoning requirements.

3.1 Recognize Use of Water Demand Calculator Through the Plumbing Code.

[11] AWE financing sustainable water resources are available at www.allianceforwaterefficiency.org/resources/financing-sustainable-water

OCPC and its communities should urge the State of Massachusetts to adopt the International Association of Plumbing and Mechanical Officials (IAPMO) Water Demand Calculator (WDC) as a pipe sizing alternative to ensure more accurate and efficient premise plumbing system designs. This should be done at the state level as part of the Massachusetts Uniform State Plumbing Code. Traditional plumbing codes overestimate water demand in new buildings because they do not account for the dramatic improvements in water efficiency over the past 30 years, leading to oversized pipes that are not only costly but also inefficient. The IAPMO WDC leverages modern data on water usage patterns to provide a more precise calculation of water demand, which can significantly reduce the size of pipes needed in new construction. This adjustment can lead to substantial cost savings in both materials and labor, while also reducing the environmental impact by minimizing the excessive use of resources. Accurate right-sizing of plumbing systems can enhance water conservation efforts because it reduces the amount of water wasted while waiting for hot water.

Several states have successfully adopted the IAPMO WDC, which is Appendix M to IAPMO's Water Efficiency and Sanitation Standard (WEStand).[12] States such as California, Arizona, and Washington have integrated this advanced tool into their regulations, recognizing the benefits of more accurately predicting water usage and demand. These states have paved the way for others to follow, showcasing the practical and environmental advantages of utilizing modern data-driven approaches to plumbing system design. Some states and local governments that have adopted the WDC calculator have done so by permitting it as an alternative sizing methodology. AWE recommends that the WDC be recognized and allowed by the state for new multifamily development.

3.2 Use the AWWA M22 Manual for Sizing Service Lines and Meters

AWWA recently released the fourth edition of its *M22 Manual for Sizing Water Service Lines and Meters*. AWE recommends that utilities use the new edition to size all new service lines and meters installed in new development and as part of any utility meter replacement program. Existing practices for sizing service lines and meters often overestimate water demand from new development because it does not account for the dramatic improvements in water efficiency over the past 30 years, leading to oversized service lines and meters. This problem is most acute in new multifamily buildings. Oversized meters can present a problem because they do not accurately measure lower flows, which are common in new development given how efficient new fixtures and appliances have become. Not only does this result in a loss of revenue for utilities, but it also increases unaccounted-for water or, to use the AWWA water loss methodology, apparent losses because water is being used without being accurately measured. From a conservation perspective, this also weakens the conservation price signal received by building owners.

3.3 Monitor and Update State Point of Sale Requirements for Water-Efficient Products

[12] More information on WEStand is available at www.iapmo.org/we-stand.

Massachusetts recently took action to require that only high-efficiency products be sold in the state. In the Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy (Bill S.9 (192nd 2021-2022)), Massachusetts established new requirements for water-efficient fixtures relevant to residential water use, as shown in **Table 3-1**. These requirements became effective on January 1, 2023. :

Table 3-1. Massachusetts requirements for water-efficient fixtures for residential water use

Plumbing Fixture	Federal Minimum Requirement	New 2023 MA Requirement
Bathroom faucet	2.2 gpm	1.5 gpm
Kitchen faucet	2.2 gpm	1.8 gpm
Showerheads	2.5 gpm	2.0 gpm
Toilets	1.6 gpf	1.28 gpf

gpm = gallons per minute; gpf = gallons per flush

In addition to water-efficient plumbing fixtures, this act also requires WaterSense-labeled spray sprinkler bodies, which help regulate pressure and save water in landscape irrigation systems. The water savings from these changes and how they affect CDM Smith's demand projections are addressed in Appendix A of this memorandum on passive efficiency. To continue down this path towards greater indoor efficiency in the future, AWE recommends that this act be amended to require WaterSense-labeled irrigation controllers. According to the Appliance Standards Awareness Project's 2024 savings report, requiring WaterSense irrigation controllers could save 1,212 million gallons per year by 2040.[13] Colorado and Nevada both require WaterSense irrigation controllers, and more states are expected to do so in the near future.

Going forward, AWE recommends that the state monitor developments in the WaterSense program and revise its state law to include requirements for any new product types or more-efficient water use for existing products. WaterSense is currently working on new and revised standards for the following products: spray sprinkler nozzles, kitchen faucets, bathroom faucets, and point-of-use reverse osmosis systems.

3.4 Consider Adopting Local Irrigation System Efficiency Requirements.

New single-family residential development frequently includes in-ground automatic landscape irrigation systems. This is true even in areas like the OCPC region where these irrigation systems have not been common historically and may not regularly be needed based on local climate and rainfall patterns. This increase in use is due to several factors, including the low cost of new irrigation systems, the ease of use of these systems by developers when new landscapes are being established and require more watering, and the increasing presence of national homebuilders who have adopted this practice in other dryer regions. The frequent installation of these irrigation systems in new development is significant because the mere presence of these systems tends to increase outdoor water use.

[13] appliance-standards.org/sites/default/files/2024_Massachusetts_Appliance_Standards_Savings_Report.pdf

For any communities in the OCPC region that anticipate meaningful numbers of new single-family homes on larger lots and have concerns about irrigation and system peaks, they could consider adopting the irrigation efficiency standards from WEStand Section 415, which focuses on design and installation, control systems, performance requirements, and inspection and performance checks. Interested communities would also have to incorporate these requirements into their existing plan review, permitting, and inspection procedures.

3.5 Consider Water Use in Land Use Planning Efforts.

Regional and local planning could consider, in more detail, the water use implications of the family zoning requirements for MBTA communities. The good news, in terms of water use, is that one can anticipate and plan for the fact that new multifamily housing is very water-efficient on a gallons per capita basis. This is supported by the Water Research Foundation Project #4554 titled "Water Use in the Multi-Family Housing Sector." It found that "[a]s housing becomes denser in terms of the average number of units per acre, average water use per dwelling unit tends to decrease" and that difference in outdoor water use on a per-person basis is largely responsible for differences in water use. Therefore, additional multifamily development in MBTA communities is consistent with the goal of becoming more water-efficient and reducing a community's residential gallons per capita day metric. OCPC, in its regional plans and through its work on local comprehensive plans, could clearly articulate this point as one of the benefits of denser housing choices.

For any communities in the OCPC region that anticipate meaningful numbers of new single-family homes on larger lots and have concerns about irrigation and system peaks, regional and local planning could highlight that these homes are expected to have higher-than-average per capita water use. Land use planning efforts should be coordinated closely with water utilities to ensure there is adequate water supplies and peak water system capacity for serving higher-than-average summer and peak water demands. Ensuring land use and water planning are coordinated and based on similar understanding of future single-family growth will avoid unexpected costs related to water supplies, permits, and infrastructure.

3.6 Consider WaterSense-Labeled Homes Program

One comprehensive way to address water use in new homes is through the WaterSense-labeled homes programs, which can be used for both single and multifamily homes. The WaterSense-labeled homes program is designed to save water in new homes through a performance-based approach. This program ensures that newly constructed home are at least 30% more water-efficient than typical new construction. While there are a few prescriptive elements, this program primarily focuses on overall water performance, thus allowing builders flexibility in achieving water savings. To ensure compliance, each home must undergo a thorough inspection and certification process by a third-party verifier. This verification guarantees that the home meets all WaterSense criteria, ultimately leading to reduced water usage, lower utility bills, and a positive environmental impact.

OCPC communities could consider promoting or incentivizing the WaterSense-labeled homes program for new residential construction. To promote the program, OCPC and interested communities could develop relationships with and offer educational programming for homebuilders active in the area and for organizations like the Home Builders and Remodelers Association of Massachusetts.

Communities could also work with affordable housing developers in the region to encourage them to incorporate WaterSense-labeled homes into their programs, given that labeled homes could save between $388 and $978 annually on utility bills. To have a greater impact, communities could consider offering homebuilders rebates or discounts on tap fees. For example, the Central Arizona Groundwater Replenishment District (CAGRD) is offering rebates of $1,000 per WaterSense-labeled home and has budgeted up to $150,000 for this effort.[14]

4.0 Recommendations for Efficiency and Affordability

4.1 Partner with Energy Efficiency and Housing Groups

To stretch limited staff and budgets, many water utilities seek to coordinate and partner with energy efficiency and housing groups operating in their service areas, including those focused on electricity and gas. This can be as simple as coordinating with these groups to ensure they are including water efficiency best practices in their existing programs that may affect water usage. For example, energy efficiency programs often include water efficiency as it relates to hot water, including items such as showerheads, faucets, and washing machines.[15] Water utilities and OCPC can coordinate to ensure these efficiency improvements are being offered and that they are using the best available technology.

Partnerships can also be more formal where one or more water utilities partner and provide funding to ensure more types and greater numbers of water-efficient products are being included in efficiency retrofit programs and in new affordable housing developments. For example, a water utility could provide funding to affordable housing developers to offset some of the costs of EnergyStar front-loading washing machines, which are the most-efficient products available on the market. AWE recommends that OCPC begin this process by developing an inventory of existing energy efficiency and housing organizations and programs and then facilitating roundtable discussions between these groups and the communities and utilities in the region.

4.2 Water Leak Bill Adjustment Programs

In addition to the leak detection programs, AWE recommends that all utilities in the OCPC region offer bill relief for water leaks when the customer can show they have fixed the underlying issue. Offering this adjustment provides an incentive to fix leaks because the bill reduction can offset the cost of repairs. It is also an equity and affordability issue because with quarterly billing in the region, it is possible that leaks will continue for long periods undetected. It is common for customers to receive unexpectedly high water bills because of hidden leaks, line breaks, or leaky toilets, such as in a bathroom rarely used. Some programs are limited to service line leaks and others cover high bills from customer-side leaks more broadly. Many utilities across the country have established programs where they will forgive a portion of the customer's bill if they can show evidence that they fixed the leak or other underlying issue. The following are a few example programs:

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[14] https://www.resnet.us/articles/cagrd-offers-1000-rebates-for-watersense-labeled-homes-in-arizona/
[15] Washing machines are referred to in DOE and EPA regulations and programs as clothes washers.

- August, GA – Adjustments due to Leaks: Program applies to all leaks on customer side of the meter that a plumber certifies as repaired. Customer is only charged for their average water use plus one-half of the additional water usage for the applicable billing periods.

- Cincinnati, OH – Leak Adjustment Program: Program only applies to service line leaks on the customer side of the meter. Leaks must be located and repaired within 30 days. Customer charge will be adjusted based on the size of the leak up to $1,000.

- Garland, TX – Leak Adjustment: Program applies to all leaks on customer side of the meter that have been repaired and result in water use returning to normal. Plumber certification is not required if customer shows receipts from making the repair themselves, such as a receipt for materials purchased from a hardware store. Size of bill credit appears to be at the discretion of the utility.

- Newport News, VA – Water Leak Adjustment Policy: Program applies to all leaks on customer side of the meter that have been repaired and results in water use returning to normal. Plumber certification is not required if customer shows receipts from making the repair themselves, such as a receipt for materials purchased from a hardware store. Credit is limited to 50% of the water and sewer consumption charges above the 12-month average usage for the account.

These programs help promote efficiency by addressing the underlying leak and also promote affordability and good customer service by avoiding the financial hardship associated with unexpected high bills.

4.3 Education and Conservation Kits

As part of its public education efforts, utilities in the OCPC region could consider holding educational events for groups of customers, organizations, and locations that are likely to reach low- and moderate-income customers. Additionally, giving these customers conservation kits can help empower them to make changes at home. Common components of conservation kits include showerheads using 1.5 gpm, 1.0 gpm faucet aerators, and dye tablets for toilet leak detection. These kits will not make a big impact on water demands, but they are a tangible way to reach customers and encourage conversation, which can be especially important for low- and moderate-income customers.

5.0 Recommendations for Drought Preparation and Response

5.1 Develop local public water supply drought management plan

During drought, it may be necessary for communities in the OCPC region to respond with additional water conservation and efficiency measures. Massachusetts recently updated its Massachusetts Drought Management Plan in December 2023 (MA Drought Plan), and Section 8: Drought Preparedness and Response Actions – Guidance for Communities provides an excellent road map for communities to follow. Specifically, AWE recommends that each OCPC community focus their attention on Section 8.1.2 and follow the steps to develop a local public water supply drought management plan.

Based on AWE's perspective and experience in the eastern United States and throughout North America, several points are worth emphasizing further. Also, AWE published a study titled "Use and Effectiveness of Municipal Irrigation Restrictions During Drought Executive Summary" in January 2020 (Drought Restrictions Study).[16] It includes a retrospective study about how well local drought restrictions performed in reducing water use during a drought.

One key recommendation from the Drought Restrictions Study is that the design of irrigation restrictions should be specific to the local region. Some states and communities with higher levels of rainfall adopted 2- and 3-day per week water restrictions based on examples from the arid West, and these did not yield any water savings in communities outside of these arid regions. Looking at Massachusetts' irrigation restrictions, which can be either 1 day per week or a ban on automatic landscape irrigation systems, AWE recognizes that these levels of restrictions are likely necessary to ensure water savings will be achieved in the OCPC region, given its relatively high rainfall and temperate climate. AWE supports and endorses the approach in the MA Drought Plan.

5.2 Focus drought education and response on largest irrigators

The Drought Restrictions Study also recognized that the utility is a reliable and important information source during drought. It recommends that utilities "should keep residents informed and educated with regard to emerging conditions; suggest ways to reduce demand in the short-term; guide residents toward resources that can help them lower demand; and leverage peer pressure through social media to discourage water waste." AWE recommends that utilities focus their educational efforts on customers that typically use the largest amounts of water for landscape irrigation and, therefore, likely represent the greatest opportunities for savings. Billing data are one of the best ways to identify areas where these customers are most prevalent. Partnering with local irrigation and landscape contractors can be a good way to raise awareness and ensure compliance. While education about drought restrictions is an important baseline for effective drought response, education alone will not significantly lower water demands.

[16] The executive summary of this report is available on AWE's website at https://www.allianceforwaterefficiency.org/impact/our-work/use-and-effectiveness-municipal-irrigation-restrictions-during-drought.

5.3 Adopt local bylaws for enforcement of drought restrictions

It is especially noteworthy that, as stated in the Drought Restrictions Study, "statistically significant savings were only detected in the presence of effective and persistent messaging and enforcement programs." Based on this finding, AWE recommends that each community in the OCPC region adopt local bylaws to allow enforcement of drought restrictions, recognizing it would be used only after education and only to the extent needed. The Drought Restrictions Study found that having the relevant ordinance (or bylaw) in place prior to a drought is essential because waiting until a drought begins to pass the required ordinance (or bylaw) can result in long delays in enforcement and cause the process to become more politically charged when policy adoption and the drought are happening concurrently. The MA Drought Plan includes a model bylaw/ordinance in Appendix G: MassDEP Model Water Use Restriction Bylaw/Ordinance. Utilities should review this model ordinance/policy with their legal counsel and rely on their legal advice in the process of developing and adopting a local version.

5.4 Collaborate regionally on drought planning and messaging

To ensure some level of consistency in drought education and messaging in the OCPC region, AWE recommends that OCPC work to convene utility staff and stakeholders in developing local drought plans and bylaws/ordinances. Regional coordination is especially important given that utilities in the OCPC region often share watersheds and rely on the same resources for their water supply. Ensuring there is a more uniform message helps avoid confusion among members of the public and results in more consistent collective action. An example of this regional collaboration can be found in the Metropolitan North Georgia Water Planning District's efforts to assist utilities in the metro Atlanta area. This regional coordination resulted in the Local Drought Planning Guide for Metropolitan Atlanta and the Model Ordinance/Policy on Local Drought Response and Water Waste. These efforts and documents would need to be adapted to the requirements and needs in the OCPC region, of course, but they highlight some of the possibilities of regional collaboration. OCPC could serve as a convenor of utilities in the region to discuss drought planning and messaging as the recommendations above are being implemented and meetings could be held on a frequent basis during drought.

Attachment to Appendix D

Passive Water Efficiency and Long-Term Demand Projections in OCPC

AWE coordinated with CDM Smith to develop their baseline water demand projections, which reasonably reflect the expected changes in demand due to passive efficiency. Passive water efficiency measures are those that do not require users to change behavior. For this section, the focus on passive efficiency is also limited to water efficiency measures that do not require significant additional action by utilities or the regional or local governments in the OCPC region. As residential water demands comprise most of the total water demands in the OCPC region, this section will focus on passive efficiency related to residential water demands in three major areas—(1) indoor efficiency, (2) outdoor water use, and (3) demand elasticity based on changes in volumetric prices.

Passive Residential Indoor Water Efficiency. Indoor residential water use has and will continue to become more efficient through the planning horizon in the OCPC Regional Water Plan. Prior to the federal Energy Policy Act of 1992 (EPAct), there were no federal requirements for plumbing fixture efficiency; where state requirements around flow rates did exist, they were generally inefficient. For example, prior to the EPAct, toilets often used anywhere from 5.0 gallons to 3.5 gallons per flush; after the EPAct, there was a national requirement that toilets use no more than 1.6 gallons per flush. The EPAct covers water efficiency of plumbing fixtures, and the Department of Energy (DOE) establishes federal standards for appliance efficiency, including those that use both energy and water in the home, such as washing machines and dishwashers. DOE has established and periodically improved requirements for both residential washing machines and dishwashers.

The result of these federal requirements has been that average daily household water use has declined. This has happened at a slow but relatively steady rate as people naturally replace plumbing fixtures and appliances that breakdown or are updated in connection with remodeling projects. **Figure A-1**, sourced from the leading study of residential end uses of water,[17] shows water usage in homes and how it has changed over a 17-year period.

[17] Residential End Uses of Water Version 2, 2016 (Water Research Foundation Project No. 4309)

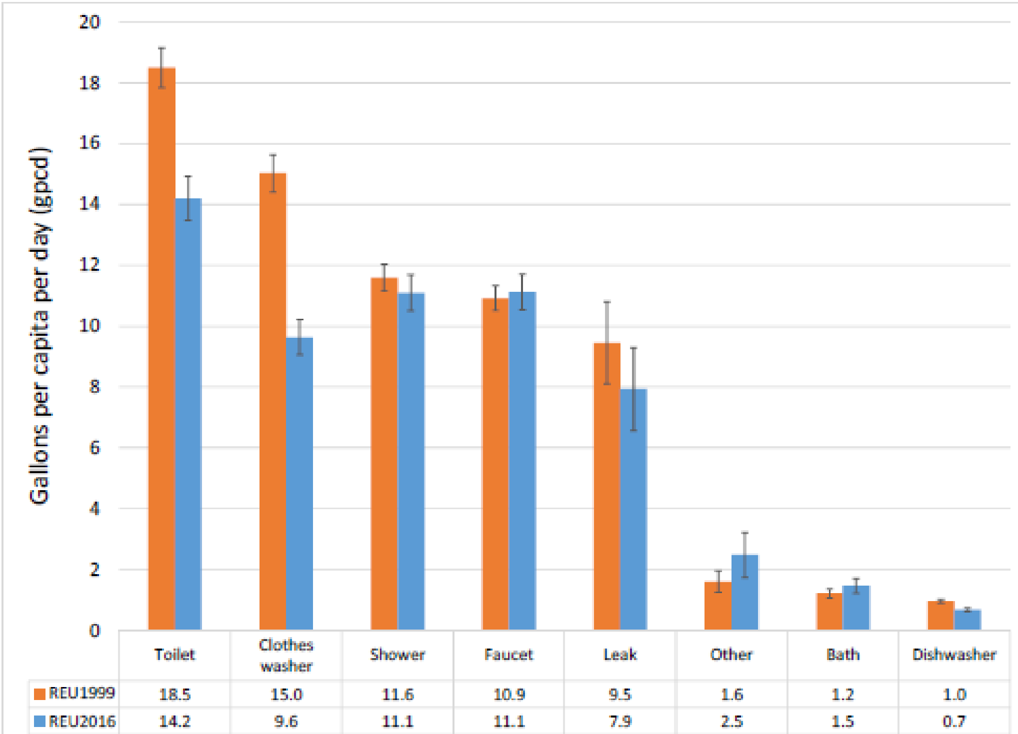

Figure A-1. Indoor Per Capita Water Use, REU1999 and REU2016

Figure A-2, sourced from the same study, shows changes in residential indoor per capita use in total instead of broken down by fixture and appliance; this figure also includes the potential per capita use for a high-efficiency home.

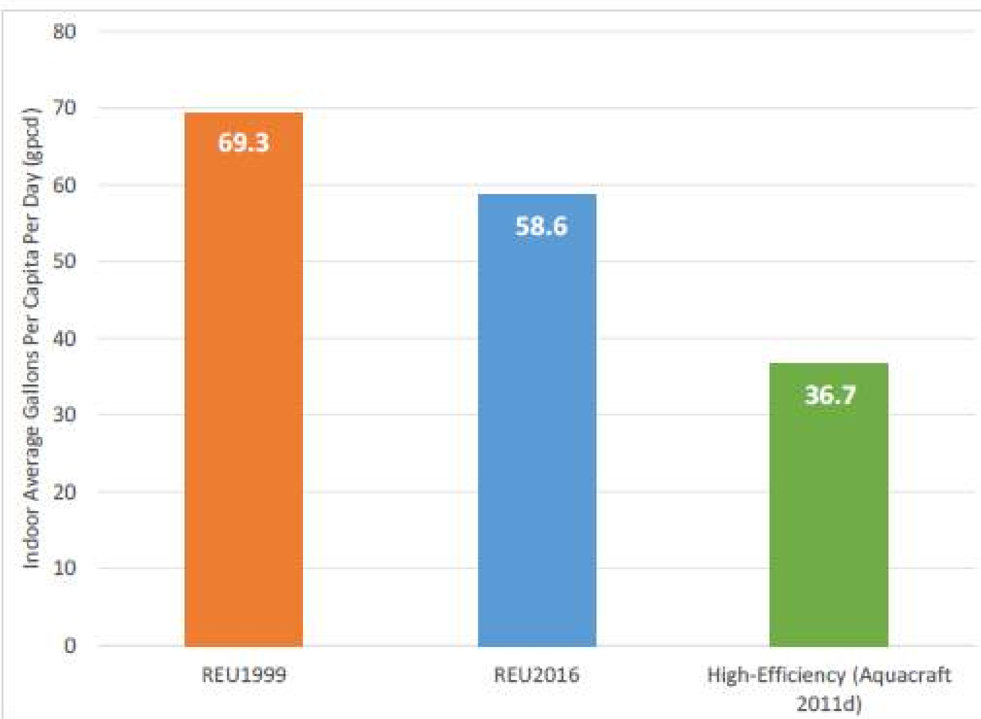

Figure A-2. Indoor Average Gallons Per Capita Per Day, REU1999, REU2016, High-Efficiency Studies

These data are approaching 10 years old, and the efficiency levels of leading fixtures and appliances have continued to improve since 2016.

Looking at the most comprehensive and current data suggests that the trend toward more-efficient indoor water use in the residential sector has continued. For example, a company named Flume Data Labs publishes a quarterly water use index based on actual water use measurements from more than 10,000 Flume Water smart devices installed in homes. The index is available at flumewater.com/water-index/. **Figure A-3** and **Figure A-4**, sourced from Flume Data Lab, show the indoor water use in the top 15 metro areas, including Boston in the green oval added for emphasis, based on the devices installed in each area.

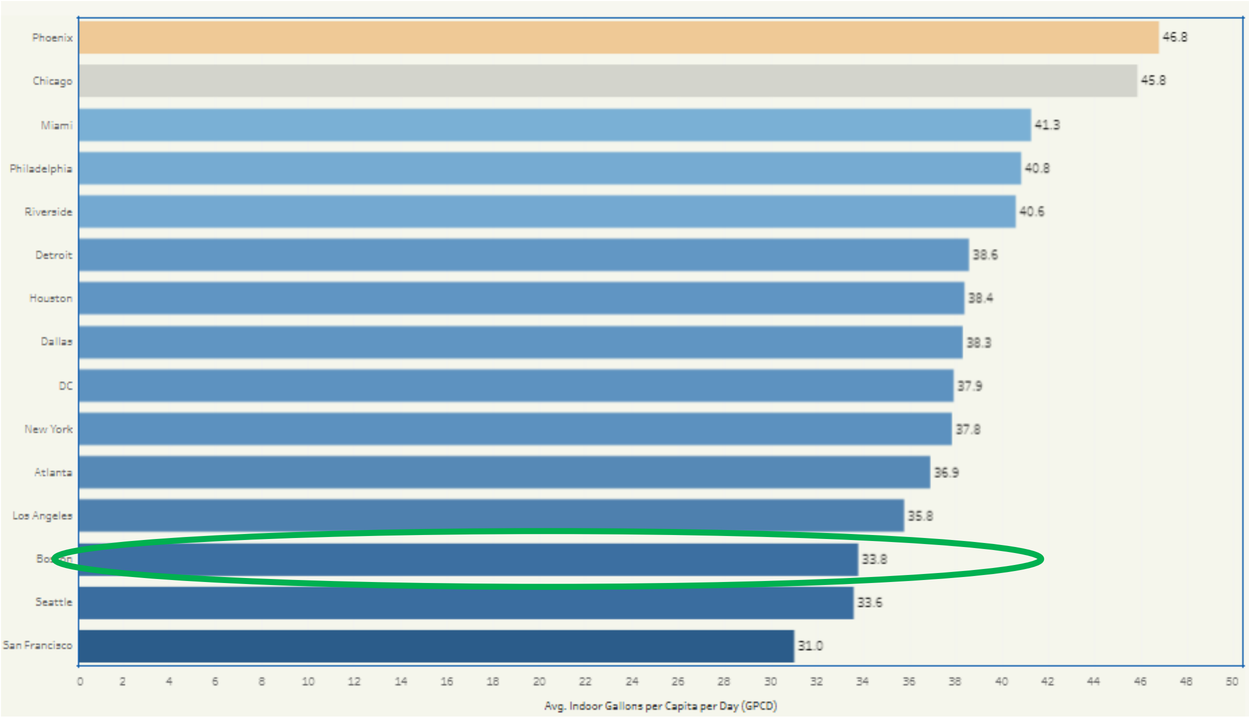

Figure A-3. Ranked Avg. Indoor Gallons per Capita Day (GPCD) for 15 Largest Metros in US

Figure A-4. Map of Avg. Indoor Gallons per Capita Day (GPCD) for 15 Largest Metros in US

The data from Flume Data Labs have been studied and are generally considered representative. Even to the extent that more representative data could be collected, there are sufficient numbers of Flume Water devices in all major metros, including the Boston metro area, to demonstrate that these levels of indoor water efficiency are easily and broadly achievable today.

Looking at the future, CDM Smith's demand projections include the future passive efficiency that one can confidently estimate. This approach is generally consistent with AWE's experience; furthermore, there are five reasons why one should expect continued improvements in passive efficiency, both nationally and in Massachusetts.

First, whether it is the EPAct requirements, federal appliance requirements, or state fixture requirements, it takes time for the stock of less efficient plumbing fixtures and appliances to be naturally replaced. This is a function of how long these products last, and it means that after a given efficiency requirement is adopted it will still take decades before the full water savings from such a change are realized. A 2022 report conducted by GMP Research on the market penetration of toilets is illustrative of this point.[18] California has a long-standing record of significant toilet replacement incentive programs, which began requiring 1.28 gpf in 2014. Nonetheless, upwards of 75% of toilets in California today still use 1.6 gpf or more. This means that there remains substantial water savings from toilets in California that will be realized as these 1.6 gpf toilets are gradually replaced. The potential for future water savings from toilets is even more true in Massachusetts, which has a much more limited history of incentivizing toilet replacements and only started requiring 1.28 gpf in January 2023, as described below.

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[18] A summary and takeaways from the GMP research study on California Market Penetration of Water-Efficient Plumbing Products Study can be found in this Plumbing Manufacturers International document – https://www.safeplumbing.org/files/safeplumbing.org/documents/misc/legacy-product-replacement-booklet.pdf.

Second, in recent years, many states have begun requiring water efficiency levels beyond the requirements of the EPAct, and Massachusetts recently took action to do the same. In the Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy (Bill S.9 (192nd 2021-2022)), Massachusetts established new requirements for water-efficient fixtures relevant to residential water use, as shown in **Table A-1**. These requirements became effective on January 1, 2023. :

Table A-1. Massachusetts requirements for water-efficient fixtures for residential water use

Plumbing Fixture	EPAct Requirement	New 2023 MA Requirement
Bathroom faucet	2.2 gpm	1.5 gpm
Kitchen faucet	2.2 gpm	1.8 gpm
Showerheads	2.5 gpm	2.0 gpm
Toilets	1.6 gpf	1.28 gpf

gpm = gallons per minute; gpf = gallons per flush

Now, as fixtures continue to be naturally replaced in Massachusetts, they will be replaced with more-efficient fixtures. The resulting water savings will accrue at a steady pace year after year during the planning horizon for OCPC.

Third, the federal appliance standards established by DOE have resulted in further advances in the water and energy efficiency of home appliances, with washing machine standards being the most impactful. DOE finalized new efficiency standards for residential washing machines in 2012 that became effective in 2018; DOE further improved on these standards in 2024 with an effective date of 2028. AWE's conservative estimate is that by 2050, and with no additional improvements to DOE standards, water savings attributable to washing machines alone can be expected in the range of 2 to 3 gallons per capita. This means a 0.8 to 1.2 MGD savings for the OCPC as a region. Much like the case with fixtures, the water savings from more-efficient washing machines and other appliances will continue to grow each year.

Fourth, many fixtures and appliances are already more efficient than required by federal and state laws. For example, the federal U.S. Environmental Protection Agency's EnergyStar and WaterSense-labeling programs recognize products that exceed the federal requirements. Additionally, many companies are already making and selling more-efficient products than required as part of their environmental social and governance goals. Home Depot, for example, has water conservation policies for products they sell in their stores. Even though Massachusetts allows showerheads of up to 2.0 gpm and bathroom faucets of up to 1.5 gpm, one can only find more-efficient products on Home Depot's shelves—showerheads using 1.75 gpm or less and bathroom faucets using 1.2 gpm or less.[19] The bottom line is that large corporations are often selling products that go beyond the underlying efficiency requirements.

Fifth, between now and 2050, it is almost certain that we will see new federal and state efficiency requirements as well as new more-efficient products being developed and sold voluntarily into the marketplace. For appliance efficient requirements, DOE is required by the EPAct to review its requirements at least every 6 years. While DOE can perform a review and decide not to revise its efficiency requirements, it seems likely that it will revise the washing machine standard again, given that many products on the market today are already more efficient than the most recent requirement.

[19] See the Home Depot document titled "Responsible Product Standards: A Better World through Better Products" Version 5.0 in October 2021.

Outdoor Water Use

There are two major factors that would exert downward pressure on outdoor demands in the future. First, to the extent new development in the OCPC region is expected to be redevelopment and infill development, these developments are likely to have smaller irrigated areas and be more water-efficient development types, such as townhomes and apartments, which have far smaller lawns and irrigated landscapes per unit. Furthermore, these development types typically do not include backyard pools, spas, and water features, such as fountains and ponds. Second, the same state law that requires more-efficient plumbing fixtures also requires that WaterSense-labeled spray sprinkler bodies be used.
In contrast, increasing temperatures, lower rainfall amounts, and longer summer irrigation periods are likely to exert upward pressure on outdoor water demands in the future. The effect of these climactic factors is uncertain at this point, and both the climate and utility outdoor water demands should be monitored and demands revisited as necessary. Because of the potential for these upward pressures on water demands, it may make the most sense to take a wait-and-see approach rather than adjusting the outdoor water use aspects of the demand projections as this point. In balancing these two factors, CDM Smith's approach of leaving outdoor demands constant is reasonable and consistent with both past experience and practice in other places in the United States.

Demand Elasticity

CDM Smith's demand projections do not account for demand elasticity, but it is expected that increases in volumetric water prices over time will result in downward pressure on water demands. AWE's *Sales Forecasting and Rate Model User Guide* and associated Excel model address this topic extensively; the guide and model are available for free on AWE's website.[20] Demand elasticity is a parameter that measures the responsiveness of water demand to changes in volumetric rates. Specifically, it measures the percentage change in demand given a 1% change in the volumetric rate. For normal goods, like water, demand elasticity is a negative value, indicating that as price increases, demand decreases. Demand is termed inelastic if the demand elasticity is between 0 and −1. The majority of empirical studies have concluded that most municipal and industrial water demands are inelastic, with demand elasticity typically falling in the range 0 to −0.5. However, demand elasticity is not binary, and even relatively inelastic demands are still affected by price increases. For example, if the elasticity parameter is set to −0.25 and the proposed volumetric rate increases by 10%, then the elasticity parameter would adjust water use down by −2.5% (−0.25 × 10%).

Like regions and utilities across the country, one can reasonably expect that water rates will increase at or above the background rate of inflation. According to the AWWA/Raftelis 2021 Water and Wastewater Rate Survey, water rates increased annually from 1998 to 2020 at a rate of 4.61%. Rates are rising faster than inflation for a variety of reasons, including the increasing age of the typical water system, competition for construction materials and labor, and increasing regulatory compliance costs. These expense trends and, therefore, the rates needed to recover these costs are likely to continue on or above this historic trajectory. If water rates increase at an inflation adjusted rate of 1% per year and there is a demand elasticity of −0.25, then (in the long term) demands are likely to decrease as a result of 0.25% per year. However, these calculations are complex, depending on rate structures, and tend to result in the largest demand decreases at higher usage levels where more water use is discretionary.

[20] See www.allianceforwaterefficiency.org/resources/financing-sustainable-water/sales-forecasting-and-rate-model

Appendix E OCPC Regional Plan Alternatives Memorandum

Memorandum

To: *Old Colony Planning Council Regional Water Plan Steering Committee*

From: *CDM Smith*

Date: *November 25, 2024*

Subject: *OCPC Regional Plan Alternatives Memorandum*

The Old Colony Planning Council (OCPC) is leading a joint effort to develop a Regional Water Plan to plan for future water supply while tackling immediate vulnerabilities. As part of the planning process, the project Steering Committee developed and evaluated alternatives to address risks to the region's water supply. Although some communities started the planning process assuming water demands would grow, CDM Smith's demand analysis indicated that water demand across the OCPC region is projected to decrease between 2025 and 2050 due largely to passive conservation anticipated from new regulations for new and replacement appliances. This analysis is documented in the 2024 Memorandum titled "Old Colony Planning Council Regional Water Plan – Water Demand Projections" (CDM Smith 2024a). Despite this projected decrease in demand, the Steering Committee identified additional risks to water supply including water quality impairments such as per- and polyfluoroalkyl substances (PFAS), climate change impacts to supply, deterioration of ecological health, sea level rise, aging infrastructure, Massachusetts Bay Transportation Authority (MBTA) zoning requirements for additional development, uncertainties in Water Management Act (WMA) renewals, and uncertainties in future state and federal drinking water regulations. To address these risks, the Steering Committee developed a suite of alternative projects and policies. CDM Smith then guided the Steering Committee through an evaluation of these alternatives with the goal of developing a strategic portfolio of local and regional alternatives to implement. This memorandum summarizes the development and evaluation of alternatives.

Alternatives Development

The approach for the development of alternatives in summarized in **Figure 1**. Alternatives were developed based on individual stakeholder interviews, recommendations from past reports as summarized in the Annotated Bibliography (CDM Smith 2024b), and a poster activity in Workshop 4 in June 2024. In the poster activity, each present Steering Committee member answered the following questions:

1. What are you committed to right now and in the next 5 years?
2. Longer term, do you feel there is a need for redundancy for drought, cyber security, short term issues or other concerns? Are you open to the following:
    a. MWRA
    b. Desalination
    c. Municipal Interconnections
    d. Reclaimed Water for Non-Potable Use
    e. Other

3. What are actions that your organization would like to see included in the Regional Water Plan?

Figure 1 Approach to Development of Alternatives for the OCPC Regional Water Plan

CDM Smith organized and consolidated the results of the above activities in a list of alternatives presented to the Steering Committee in Workshop 5. The steering committee refined the alternatives through discussions in Workshop 5 and 6. Alternatives were grouped into long-term or short-term alternatives based on whether they could likely be implemented in the next five years. They were also grouped as local or regional depending on whether they required coordination among communities. Each alternative is summarized in a fact sheet in **Attachment A**. Each fact sheet includes a brief description of the alternative, key assumptions, yield (in terms of new supply or demand reduced), cost, and risk considerations. **Table 1** summarizes the alternatives considered and which communities would or could participate.

Table 1 Alternative Summary

Category	ID	Project General Description	Communities/ Stakeholders to Whom This Could Apply
Long-Term Local Alternatives	LT-1	Access to Clean Water for Private Well Owners – Connection to Public Water Supply	All OCPC communities except Plympton
	LT-2	New Public Wells	Abington, Bridgewater, Brockton, Duxbury, East Bridgewater, Easton, Halifax, Hanover, Kingston, Pembroke, Plymouth, West Bridgewater
Long-Term Regional Alternatives	LT-3	MWRA For Entire OCPC Region with Public Water Supply – Replacing Entire Permitted Amount	All OCPC communities except Plympton
	LT-4	MWRA For Entire OCPC Region with Public Water Supply – Supplying Requested Amount	All OCPC communities except Plympton
	LT-5	MWRA for Communities Who Indicated Openness to MWRA[1]	Abington, Avon, Bridgewater, Easton, Pembroke, Plympton, West Bridgewater
	LT-6	MWRA For Communities Actively Exploring MWRA Connection	Abington, Avon, Hanover
	LT-7	MWRA For Communities Bordering Existing MWRA Connection	Avon, Easton
	LT-8	New Emergency Interconnections	Easton, Plympton, West Bridgewater
	LT-9	Reclaimed Water for Non-Potable Uses	Bridgewater, Easton, Kingston, Plymouth, Agriculture Users in all OCPC communities
Short-Term Local Alternatives	ST-1	Conduct, Validate and Act on Annual American Water Works Association Water Loss Audits	All OCPC communities except Plympton
	ST-2	Rebates for Leak Detection Devices for Customer-Side Leak Detection	All OCPC communities except Plympton
	ST-3	Advanced Metering Infrastructure (AMI)	All OCPC communities except Plympton
	ST-4	Improve Increasing Block Rate Designs or Billing Intervals	Abington, East Bridgewater, Halifax, Whitman
	ST-5	New Public Wells	Bridgewater, Hanson, Kingston, Pembroke, Plymouth
Short-Term Regional Alternatives	ST-6	Aquaria Desalination 1[2]	Avon, Brockton, Easton, Hanson
	ST-7	Aquaria Desalination 2[2]	Avon, Bridgewater, Brockton, West Bridgewater
	ST-8	Aquaria Desalination 3[2]	Brockton, Duxbury, Halifax, Hanson, Pembroke

[1]These are communities that indicated openness to MWRA at Workshop 5. Not every community was present at this workshop so this alternative may not be inclusive of all OCPC communities open to MWRA.

[2]These subgroups of communities are intended to be representative of ways that Brockton could share desalinated water but are not necessarily expected to be rigid or exclusive in these definitions.

Through workshop discussions, the Steering Committee decided that some alternatives were better described as best practices that should be recommended in the Regional Water Plan without the need for comparison to other alternatives. These recommendations are summarized in **Table 2** and further described in fact sheets in **Attachment B**.

Table 2 Best Practice Recommendations

Project General Description	Communities/ Stakeholders to Whom This Could Apply
Redundant Water Supply for Agriculture	Agricultural Users in the OCPC Region
Regional Coordination for PFAS Management and Funding	All OCPC communities
Identification and Removal of Migratory Obstructions	Jones River Watershed Association, Taunton River Watershed Association, North and South Rivers Watershed Association
Support Agricultural Water Use Efficiency (Grants for Research and Implementation)	Agricultural Users in the OCPC Region
Access To Clean Water for Private Well Owners - Education	All OCPC communities
Native Landscaping Education and Potential Local By-Laws	All OCPC communities
Registration Holders and Private Well Outdoor Water Use Restrictions Local Bylaws	All OCPC communities
Supporting Public Health and Awareness for Private Well Drinking Water Quality	All OCPC communities
Water Demand Offset Policies	All OCPC communities
Water Use Mitigation Program	All OCPC communities
Conduct Regular Rate Studies	All OCPC communities except Plympton
Inter-Municipal Agreements	All OCPC communities
Integrated Ecological Assessment and Improvements	All OCPC communities

Alternatives Analysis

Approach

The evaluation of alternatives requires an objective, transparent and repeatable process. The approach used to score alternatives for the OCPC Regional Water Plan is based on multi-criteria decision analysis (MCDA), a proven method to clearly see performance and trade-offs. The following terms are often associated with this ranking method:

- Alternatives – Represents either individual options or portfolios of options
- Objectives – The collective standard by which alternatives can be compared and ranked, directly representing the stated objectives of the stakeholders
- Metrics – Indices, aligned to the objectives, that indicate performance of alternatives, or potential progress toward objectives
- Weights – Importance of objectives relative to each other

The MCDA method is summarized in **Figure 2** for a simplified, example process. Steps 1 and 2 in the MCDA process involve the conversion or standardization of metrics for the objectives that are measured in different native units (e.g., cost in dollars, water supply in MGD, etc.). This allows for metrics to be added together uniformly on a scale of 0.0 to 1.0. In the example shown in Figure 2, the best possible score for a reduction in water supply shortage would be a 100% reduction, which would be associated in Step 2 with a score of 1.0. The example Alternative 5 reduces the shortage by 80% and is assigned a score of 0.8 in Step 2. Steps 3, 4, and 5 assign objectives weights to the standardized metric scores so they can be plotted for a given alternative. In this example, the reliability objective has a weight of 50 percent, so in Step 4, the objective score of 0.8 is multiplied by the objective weight of 50% to get a partial score of 0.4, shown in Step 5. Step 5 repeats the process until all scores for all objectives are estimated for each alternative. Step 6 sums the objective scores into a final score for each alternative. A theoretical alternative that scores the highest for every metric would have a maximum score of 1.0. The process results in comparable overall scores for each alternative, illustrates the strengths and weakness of an alternatives ability to meet various objectives, and highlights tradeoffs in performance between alternatives.

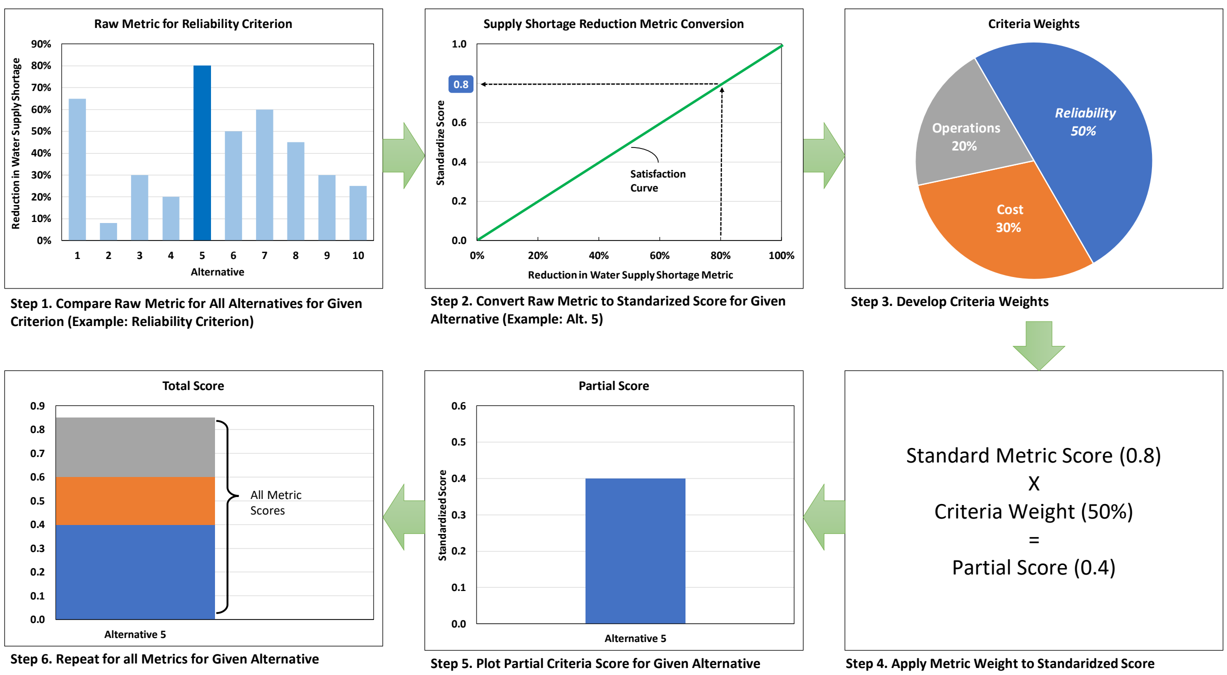

Figure 2 Multi-Criteria Decision Analysis Method (simplified example not based on OCPC factors)

The Steering Committee developed objectives that alternatives evaluated in the Regional Water Plan should aim to meet. They then assigned one or more metrics to each objective to be used to gage performance of the alternatives. The metrics had to be measurable either quantitatively or qualitatively. CDM Smith calculated values for the quantitative metrics and the Steering Committee developed qualitative scores for each alternative as part of Workshop 5. **Table 3** presents the objectives and metrics used to evaluate alternatives for the OCPC Regional Water Plan. These are further described below. **Attachment C** presents the metric scores for each alternative.

Table 3 Evaluation Criteria

Objectives	Metric	Metric Measurement
Reliable Municipal Supply	Annual Average New Supply Added of Demand Reduced	Quantified MGD yield (Highest = Best Score)
Cost Effectiveness	Unit Capital Cost per Volume of Water Provided or Demand Reduced	$/1,000 gallons (Lowest = Best Score)
Ecological Health	Connectivity of Natural Waters	1-5 Score (1=Worst Score, 5=Best Score) *1=Major detrimental impact, 2= Minor detrimental impact, 3= Neutral impact, 4= Minor positive impact, 5= Major positive impact*
	Quantity and/or quality of natural waters at the right time for ecological needs.	1-5 Score (1=Worst Score, 5=Best Score) *1= Major detrimental impact, 2= Minor detrimental impact, 3= Neutral impact, 4= Minor positive impact, 5= Major positive impact*
	Reduction in Withdrawal from Silver Lake	0/1 Binary Score (0 = Worst Score, 1 = Best Score) *0= No reduction, 1= Reduction*
Innovation	Volume supplied or demand reduced considered innovative	Quantified MGD yield (Highest = Best Score)
Fairness	% of EJ census block groups served by alternative	Quantified Percentage (0 = Worst Score, 100 = Best Score)
	% of EJ Census block groups impacted by construction	Quantified Percentage (0 = Best Score, 100 = Worst Score)
Drinking Water Quality	Volume of PFAS Impacted Supply Reduced	Quantified MGD yield (Highest = Best Score)
	Reduction in Long-Term Water Quality Risk	1-3 Score (1=Worst Score, 3=Best Score) *1 = High uncertainty for long-term risk of quality with emerging contaminants, 2 = neutral risk, 3 = low risk of future water quality concerns (MWRA and desalination)*
Efficiency and Adaptability	Flexibility in Phasing and Supply Capacity	1-3 Score (1 = Worst Score, 3 = Best Score) *1= Low flexibility in time or volume, 2= High flexibility in time or volume, 3 = Fully able to meet anticipate future needs*
	Implementation Feasibility	1-3 Score (1 = Worst Score, 3 = Best Score) *1= High difficulty in implementation, 2= Moderate difficulty in implementation, 3 = Low difficulty in implementation*

Reliable Municipal Supply

The **Reliable Municipal Supply** metric was quantified as the annual average volume of new supply added or demand reduced. As demands were projected to decrease over the planning horizon for all communities, the communities did not have a projected gap between supply and demand. To determine the supply target for each alternative, CDM Smith requested feedback from communities on the volume of new, high-quality supply they would request if available. These supply targets do not represent a firm need or commitment for new supply from the community but rather a target to use for comparative, planning purposes. For communities that did not provide a supply target, CDM Smith estimated a target supply that varied by alternative.

Steering Committee members noted concerns with meeting peak versus annual demand. For this study, annual average supplies were analyzed as is standard for a water supply planning study versus a community-specific operational study. A level of storage in communities' distribution systems could be utilized to provide additional supply buffer for some peaking. In the design phase of any alternative that is pursued, the adequacy of existing storage and need for new storage would need to be investigated. Furthermore, there is potential for costs to be overestimated if peak demands were used as a basis for planning level design costs developed as part of this project.

The annual average volume of new supply added or demand reduced is summarized in **Table 4** and **Table 5**. The green cells indicate a supply target that has been developed in coordination with the community. The remaining supply targets were estimated according to the methodology in the notes row of the table.

Table 4 Supply Volumes Provided by Each Long-Term Alternative (green cells indicate a planning supply target approved by the community)

Town	Alternatives								
	LT-1	LT-2	LT-3	LT-4	LT-5	LT-6	LT-7	LT-8	LT-9
	Private Well Connections	New Public Wells	MWRA for All - Permitted Amount	MWRA for All - Requested Amount	MWRA for Open Communities	MWRA for Actively Pursuing Communities	MWRA for Bordering Communities	New Emergency Interconnections	Reclaimed Water for Non-Potable Uses
Abington	-	1.42	3.36	2.84	2.84	2.84	-	-	-
Avon	-	-	0.61	0.25	0.25	0.25	0.25	-	0.19
Bridgewater	-	3.00	1.98	3.00	3.00	-	-	-	-
Brockton	-	4.18	16.05	8.35	-	-	-	-	-
Duxbury	-	0.79	1.51	0.79	-	-	-	-	-
East Bridgewater	-	0.47	1.21	0.94	-	-	-	-	0.22
Easton	-	3.00	2.36	3.00	3.00	-	3.00	0.017	-
Halifax	-	0.72	0.68	0.72	-	-	-	-	-
Hanover	-	0.60	1.38	1.20	-	1.20	-	-	-
Hanson	-	-	0.78	0.59	-	-	-	-	0.19
Kingston	-	0.77	1.47	1.55	-	-	-	-	-
Pembroke	-	1.00	1.84	1.00	1.00	-	-	-	-
Plympton	-	-	-	-	-	-	-	-	-
Plymouth	-	1.50	5.32	1.50	-	-	-	-	0.49
Stoughton	-	-	2.48	1.89	-	-	-	-	-
West Bridgewater	-	0.32	0.84	0.32	0.32	-	-	0.006	-
Whitman	-	-	0.86	0.43	-	-	-	0.00	-
TOTAL (MGD)	**0**	**17.77**	**42.73**	**28.37**	**10.41**	**4.29**	**3.25**	**0.023**	**1.09**
Notes		For communities that did not submit supply targets, half of the 2022 Annual Demand was assumed	2022 Annual Demands	For communities that did not submit supply targets, the 2022 Annual Demand was assumed.			Supply targets	Half the 2022 Annual Demand * 7 out of 365 days to represent an emergency supply	Assumes 80% of Annual Demand returns to the WWTF and 15% of that is made available

Table 5 Supply Volumes Provided by Each Short-Term Alternative (green cells indicate a planning supply target approved by the community)

Town	Alternatives							
	ST-1	ST-2	ST-3	ST-4	ST-5	ST-6	ST-7	ST-8
	AWWA Water Loss Audits	Rebates for Leak Detection Device	Advanced Metering Infrastructure	Improving Block Rate Designs	New Public Wells	Aquaria Desalination - Mix	Aquaria Desalination - West	Aquaria Desalination - East
Abington	1.00 Cumulative	0.28	0.14	0.28	-	-	-	-
Avon		0.04	0.02	-	-	0.25	0.25	0.25
Bridgewater		0.16	0.08	-	0.56	-	2.75	2.75
Brockton		0.84	0.42	-	-	1.00	1.00	1.00
Duxbury		0.16	0.08	-	-	-	-	-
East Bridgewater		0.09	0.05	0.09	-	-	-	-
Easton		0.18	0.09	-	-	2.67	-	-
Halifax		0.05	0.02	0.05	-	-	-	-
Hanover		0.12	0.06	-	-	-	-	-
Hanson		0.06	0.03	-	0.34	1.08	-	-
Kingston		0.15	0.08	-	0.79	-	-	-
Pembroke		0.11	0.06	-	1.10	-	-	-
Plympton		-	-	-	-	-	-	-
Plymouth		0.41	0.21	-	2.00	-	-	-
Stoughton		0.19	0.09	-	-	-	-	-
West Bridgewater		0.06	0.03	-	-	-	1.00	1.00
Whitman		0.09	0.04	0.09	-	-	-	-
TOTAL (MGD)	**1.00**	**3.00**	**1.50**	**0.51**	**4.79**	**5.00**	**5.00**	**5.00**
Notes:	Assumed a one-third reduction in total water losses.	10% of the 2022 Annual Demands.	5% of the 2022 Annual Demands.	10% of the 2022 Annual Demands.	Expected/existing well permits.	Available 5 MGD distributed to reduce PFAS risk in participating communities		

Cost Effectiveness

The **Cost Effectiveness** metric was defined as the Opinion of Probable Project Cost (OPPC) per thousand gallons of new supply added. The OPPCs are presented in 2024 dollars. There are many project costs that cannot be fully quantified at this time (planning and other pre-design costs, escalation, etc.). Therefore, these OPPC estimates should only be used to convey the relative magnitude of the investment required for the projects for comparative purposes. Should communities choose to pursue one of the evaluated alternatives, then more refined cost estimates should be developed based on more complete project information. Additionally, operation and maintenance costs are not included in this analysis. These costs represent only planning level capital costs and not the full cost of delivery of water. It was outside the scope of this project to consider the impacts on water rates for customers as a result of communities taking on these capital expenditures.

The OPPCs were developed based on the following assumptions:

- Costs include the costs of new pipelines but do not include pump stations (aside from the pump station upgrade associated with LT-7).
- Costs for new wells were developed based on costs provided by communities, escalated to 2024 dollars where appropriate.
- Costs for PFAS treatment were estimated as $3.3M per MGD based on costs provided by communities.
- Costs for regional supply options represent the cost to the region and do not include community specific costs that may be incurred to connect to a new regional supply, which may include:
  - Permit, application, and admission fees;
  - Costs for more detailed pipeline routing studies;
  - Water quality blending, hydraulic, and siting studies that will be required to further assess the viability of an interconnection. A thorough discussion of concerns related to blending of water supply sources can be found in MWRA Water and Wastewater System expansion Evaluation to south Shore Communities (CDM Smith 2022);
  - Community costs for the planning, permitting, engineering, and construction of infrastructure improvements within the community's distribution system needed to accept a regional supply;
  - Community-specific infrastructure improvements needed to accept a regional water supply, such as new or upsized water mains, pumping stations, additional storage tanks, and other improvements needed to properly accept and distribute water within the community;
  - Finance or funding costs, legal fees, and permitting fees that may need to be addressed prior to construction; and
  - No specific allowances are included for rock excavation, dewatering, and handling/disposal of contaminated soils. Additionally, no specific costs are included for utility relocations.

- Costs were developed based on annual average capacity, as this is standard for a water supply planning study versus a community-specific operational study. A level of storage in communities' distribution systems could be utilized to provide additional supply buffer for some peaking. In the design phase of any alternative that is pursued, the adequacy of existing storage and need for new storage would need to be investigated. Furthermore, there is potential for costs to be overestimated if peak demands were used as a basis for planning level design costs developed as part of this project.
- A 25 percent Construction Contingency is included.
- A 25 percent Engineering and Implementation Contingency is included.
- A 20 percent Project Contingency is included to account for project unknowns at the current planning stage.
- Some projects relied on cost estimates developed as part of other studies. These costs had their own project specific contingencies applied and were included as is without additional contingencies. For example, the MWRA alternatives incorporated the costs of MWRA extensions to the South Shore (CDM Smith 2022). The costs of the MWRA extension for this study were scaled based on the ratio of OCPC need to total extension capacity. Additional pipelines were located to bring MWRA water from the study's indicated extension locations to the identified OCPC communities.
- In cases where a new supply would prevent the need for a community to develop PFAS treatment for an existing contaminated supply, a cost credit was applied for the PFAS treatment costs avoided. PFAS avoidance credit is further discussed in the water quality metric section below. The same $3.3M per MGD cost used for the alternatives where PFAS treatment is included was used to estimate the cost savings of PFAS treatment avoided.
- Any costs developed based on cost estimates from a previously completed projects or studies were escalated to 2024 dollars for comparison. This analysis considered the year the cost was incurred or developed and the yearly average ENR construction index to escalate costs to the year 2024. This report was written before 2024 was over, so 3% inflation was assumed as an annual escalation rate from 2023 to 2024.

Cost components for each alternative are summarized in **Table 6** and **Table 7** for the long- and short-term alternatives, respectively, and are further described for each alternative in the project fact sheets included in Attachment A. Costs are rounded to two significant digits. The costs represent planning level estimates. More refined cost estimates should be developed should any alternative(s) progress to more detailed study or preliminary and final design stages of development.

Table 6 Project Costs for Long-Term Alternatives

		Project Components that have Contingencies Applied						Contingencies				Additional Project Costs		Total Project Cost
Alternative		Pipeline	Pump Station	Wells	PFAS Treat-ment	Other	Other Notes	25% Construction	25% Engineering/ Implementation	Subtotal	20% Project	Add'l Capital	Add'l Capital Notes	
LT-1	Private Well Owners - Connection to Public Water Supply	$75				$15	Cost of service line connection[1]	$19	$19	$130	$25			$160
LT-2	Long Term Wells			$230	$59					$290	$58			$350
LT-3	MWRA for All - Permitted Amount	$89						$22	$22	$130	$27	$1,300	Scaled MWRA South Shore extension[2]	$1,500
LT-4	MWRA for All - Target Amount	$63						$16	$16	$94	$19	$930	Scaled MWRA South Shore extension[2]	$1,100
LT-5	MWRA for Open Communities	$31						$7.7	$7.7	$46	$9.2	$340	Scaled MWRA South Shore extension[2]	$400
LT-6	MWRA for Actively Pursuing Communities	$17						$4.3	$4.3	$26	$5.1	$121	Scaled MWRA South Shore extension[2]	$160
LT-7	MWRA for Bordering Communities	$9.3	$1.3					$2.7	$2.7	$15	$2.9			$18
LT-8	Interconnections	$21						$5.2	$5.2	$31	$6.3			$38
LT-9	Reclaimed Non-Potable Use											$27	$/MGD from Texas projects Texas[3]	$27

[1] Cost of private well owners connection to the public supply is based on the cost of water service line connections for 50% of private well owners per town and a community approximation of miles of water main per customer served.

[2] The cost of MWRA extensions to the South Shore were used as a basis for a planning level cost estimate. Costs were scaled from the extension capacity to the supply needed for served OCPC communities.

[3] Developed using a $M/MGD based on non-potable projects in Texas. Cost estimate includes plant upgrades, piping, and 40% project contingency.

Table 7 Project Costs for Short-Term Alternatives

		Project Components that have Contingencies Applied						Contingencies				Additional Project Costs			
Alternative		Pipeline	Pump Station	Well Costs	PFAS Treat-ment	Other	Other Notes	25% Construction	25% Engineering/ Implement-ation	Subtotal	20% Project	Add'l Capital	Add'l Capital Notes	PFAS Cost Offset	Total Project Cost
ST-1	Water Loss Audit					$24	see fact sheet			$24	$4.8				$29
ST-2	Leak Detection Rebates					$13	see fact sheet			$13	$2.6				$16
ST-3	AMI					$53	see fact sheet			$53	$10.6				$64
ST-4	Billing Improvements					$0.12	see fact sheet			$0.12	$0.024				$0.20
ST-5	Short Term Wells			$100						$100	$20				$120
ST-6	Aquaria Desalination 1	$8.3						$2.1	$2.1	$13	$2.5	$65	Purchase of Aquaria desalination plant[1]	-$9.2	$71
ST-7	Aquaria Desalination 2	$15						$3.7	$3.7	$22	$4.5	$65	Purchase of Aquaria desalination plant[1]	-$20	$73
ST-8	Aquaria Desalination 3	$7.9						$2.0	$2.0	$12	$2.4	$65	Purchase of Aquaria desalination plant[1]	-$18	$62

[1] The cost of purchase is estimated to be $55M based on the MassDEP SRF loan application (Project Evaluation Form for CY 2025) submitted by Brockton in 2024. Up to $10M in additional capital investments may be necessary to operate the plant at 5 MGD.

Innovation

The metric used to evaluate the **Innovation** objective sums the amount of new supply added or demand reduced that is considered innovative. Yields associated with desalination, non-potable reuse, and the four demand-side management alternatives were considered innovative for this metric.

Fairness

The two metrics for the **Fairness** objective leveraged data on underserved populations from the state[1]. The first metric evaluated the percentage of the census block groups designated as EJ that were served by the alternative. The distribution of EJ block groups in the OCPC region can be seen in **Table 8**. For different alternatives, this may mean a new clean drinking water supply was supplied to the community or that demand side water efficiencies were added, reducing water lost and cost to consumers. A higher percentage of EJ populations served resulted in a higher score. The second metric used to evaluate the Fairness objective is the percentage of census block groups designated as EJ that would be negatively impacted during construction of the alternatives. A higher score corresponds to fewer EJ census block groups being impacted.

Table 8 Number of Underserved Block Groups per OCPC Community

Municipality	Number of Underserved Block Groups
Avon	4
Bridgewater	3
Brockton	73
Halifax	1
Hanover	1
Plymouth	4
Stoughton	18

Ecological Health

The **Ecological Health** objective was measured using three metrics. The first metric is Connectivity of Natural Waters. The Steering Committee developed a qualitative score on a scale of 1 to 5 to indicate whether each alternative had a major positive effect (5), a minor positive impact (4), a neutral impact (3), a minor detrimental impact (2), or a major detrimental impact (1) to the connectivity of natural waters.

The second metric, Quantity and/or Quality of Natural Waters at the Right Time for Ecological Needs, assessed whether the alternative would result in an improvement in the quantity or quality of surface and/or groundwater in the region. The Steering Committee considered whether each alternative could result in an improvement and at what scale. The Steering Committee developed a qualitative score on a scale of 1 to 5 to indicate whether each alternative had a major positive effect (5), a minor positive impact (4), a neutral impact (3), a minor detrimental impact (2), or a major detrimental impact (1) to the quantity and or quality of natural waters. During the steering committee workshop on August 27, 2024, a small group evaluated different alternatives using this qualitative score.

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[1] https://www.mass.gov/info-details/massgis-data-2020

The third metric, Reduction in Withdrawal from Silver Lake, considers whether the alternative could result in a reduction in the withdrawals from Silver Lake with the goal of restoring ecosystem services provided by the lake.

The **Drinking Water Quality** objective was split into two metrics. The first metric, Volume of PFAS Impacted Supply Reduced, considers the existing PFAS risk faced by each community and the timing of the new alternative. Communities must address PFAS in their supply with new treatment to below MCL by 2029 or find an alternative supply to replace the PFAS-impacted supply. If an alternative could provide a community with a new, PFAS-free supply before the regulatory compliance deadline in 2029, the volume provided is assumed to offset an equivalent portion of the community's PFAS-impacted supply. It was assumed that that desalination alternatives could be brought online prior to 2029 and would eliminate the need for communities to treat that portion of their supply. MWRA alternatives would not result in available water prior to 2029. For each community, the volume assumed to be at risk of PFAS and the portion of this volume the community has committed to treating either by securing funding or beginning design/construction were considered to determine the remaining volume of PFAS impacted supply that a new alternative could possible replace. For each alternative, the minimum of the volume of PFAS impacted supply remaining and the volume delivered by the new alternative was summed to yield the total Volume of PFAS Impacted Supply Reduced. **Table 9** shows the calculation of this metric for the three applicable Aquaria Desalination alternatives.

Table 9 PFAS Treatment Avoided by Alternatives

			ST-6 Aquaria Desalination 1		ST-7 Aquaria Desalination 2	ST-8 Aquaria Desalination 3
Community	Current PFAS Impacted Supply (MGD)	Remaining PFAS Impacted Supply After Committed Treatment (MGD)	Supply Delivered (MGD)/ PFAS Treatment Avoided (MGD)	Supply Delivered (MGD)/ PFAS Treatment Avoided (MGD)	Supply Delivered (MGD)/ PFAS Treatment Avoided (MGD)	Notes
Abington	3.84	0				PFAS treatment underway for all sources
Avon	0.25	0.25	0.25/0.25	0.25/0.25		PFAS treatment not yet underway at Porter Well
Bridgewater	3.06	3.06		2.75/2.75		PFAS treatment not yet underway
Brockton	1.08	1.08	1/1	1/1	1.41/1.08	PFAS treatment not underway at Brockton Reservoir
Duxbury	0.79	0.53			0.79/0.53	Received funding for PFAS treatment of one well
East Bridgewater	2.88	2.88				PFAS treatment not yet underway
Easton	1.69	0	2.67/0			PFAS treatment completed
Halifax	0.72	0.72			0.72/0.72	PFAS treatment not yet underway
Hanover	4.58	4.58				PFAS treatment not yet underway
Hanson	1.08	1.08	1.08/1.08		1.08/1.08	PFAS treatment not yet underway
Kingston	0	0				No PFAS in active wells
Pembroke	1	1			1/1	PFAS treatment not yet underway
Plymouth	0	0				No PFAS
Plympton	0	0				N/A
Stoughton	1.95	1.05				PFAS treatment underway for two locations
West Bridgewater	4.11	4.11		1/1		PFAS treatment not yet underway
Whitman	0	0				Purchases all water from Brockton

Total	**27.03**	**20.34**	**5/2.33**	**5/5**	**5/4.41**	

The second metric, Reduction in Long-Term Water Quality Risk, considers the level of uncertainty in long term water quality of the different sources. The alternatives that have minimal uncertainty (that score well) are desalination and MWRA alternatives. It is assumed the Reverse Osmosis (RO) treatment used to produce desalinated water would remove any other emerging contaminants of concern and that water purchased from MWRA would be treated to drinking water standards. Alternatives with high uncertainty (that score poorly) are the new groundwater well alternatives, as there may be emerging contaminants of concern or stricter limits for existing drinking water standards. The remaining alternatives, including demand-side management alternatives, were given a neutral score.

The **Efficiency and Adaptability** objective was split into two qualitative metrics. The first metric, Flexibility in Phasing and Supply, was developed by the Steering Committee to represent the ability of an alternative to be adapted to water supply needs based on uncertainty surrounding demand growth. New MBTA zoning standards may result in high density housing near MBTA locations, which creates an uncertainty in demands. An alternative scores well with respect to this metric if the supply is flexible in volume or time of implementation. The Steering Committee assigned each alternative a qualitative score of 1 to 3.

The second metric, Implementation Feasibility, represents how difficult an alternative may be to implement based on factors such as ability to acquire required permits, existence of public and/or political opposition, and extent of construction impacts. The Steering Committee assigned each alternative a qualitative score of 1 to 3.

Finally, each member of the Steering Committee was asked to assign weights to the objective to reflect their relative importance. This information could then be used to compare how favorable or unfavorable various alternatives are with respect to each Steering Committee member's weightings, with the goal of identifying alternatives that address multiple objectives versus those that address a more limited subset of objectives only, or which offer very little progress toward any objectives. The weighting responses to this activity were anonymized and summarized in **10**. Not every Steering Committee member submitted weights. A regional representative score, shown in the far right column of **10**, was developed based on the average of responses received. Figure 3 illustrates the distribution of weightings. While there was general agreement on weightings for ecological health and fairness, there was greater variation in weightings for drinking water quality and reliable municipal supply.

Table 10 Objective Weightings

Stakeholders →	A	B	C	D	E[1]	F	G	H[1]	I	J	K	L	M	N	Representative
Reliable Municipal Supply	35	20	16	0	30/33	25	40	30/27	25	20	25	0	15	20	20
Ecological Health	5	10	10	0	10/11	5	3	10/9	5	10	5	37	5	40	10
Cost Effectiveness	7	15	23	0	10/11	20	8	10/9	25	10	10	0	15	5	10
Innovation	3	10	6	0	5/6	5	3	15/14	5	5	5	5	5	5	5
Fairness	10	5	11	0	5/6	5	3	13/12	0	14	10	3	5	10	10
Drinking Water Quality	20	20	19	100	20/22	25	40	12/11	25	27	25	47	50	10	30
Efficiency & Adaptability	20	20	15	0	10/11	15	3	20/18	15	14	20	8	5	10	15
TOTAL	**100**	**100**	**100**	**100**	**90/ 100**	**100**	**100**	**110/ 100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

[1] Two communities' scores did not sum to 100 and were subsequently scaled in the entries to the right

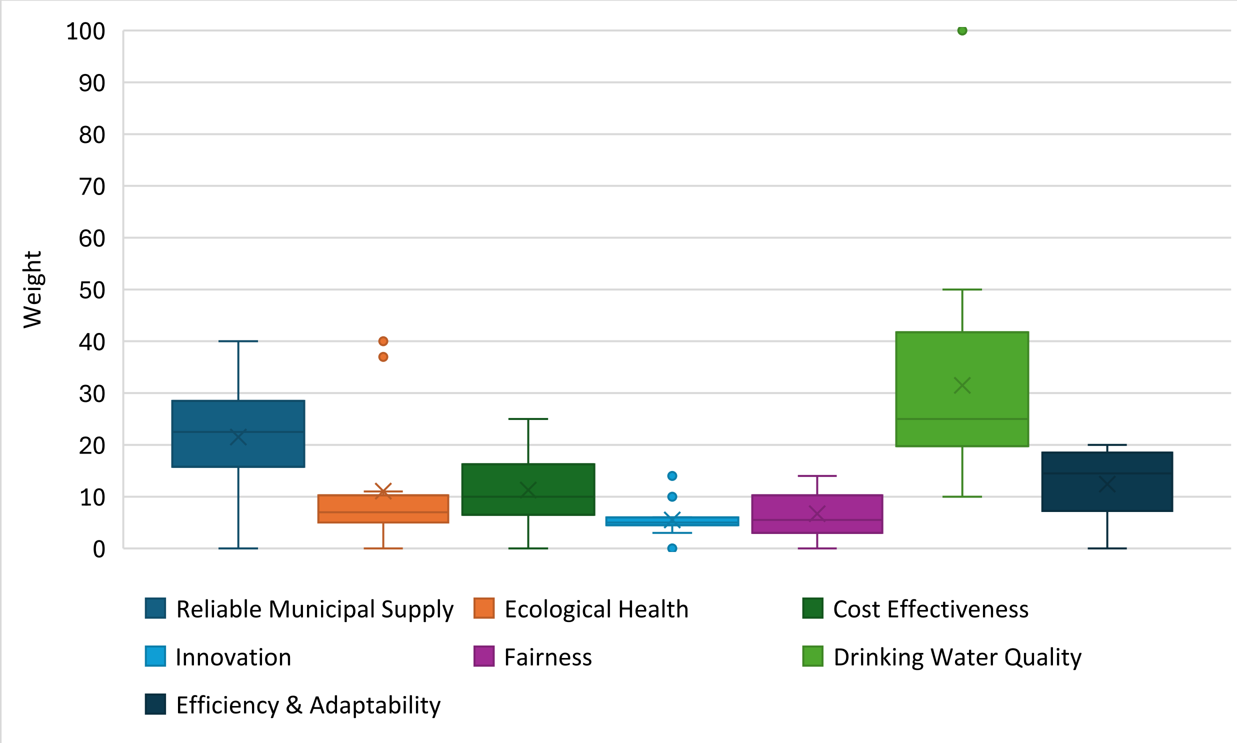
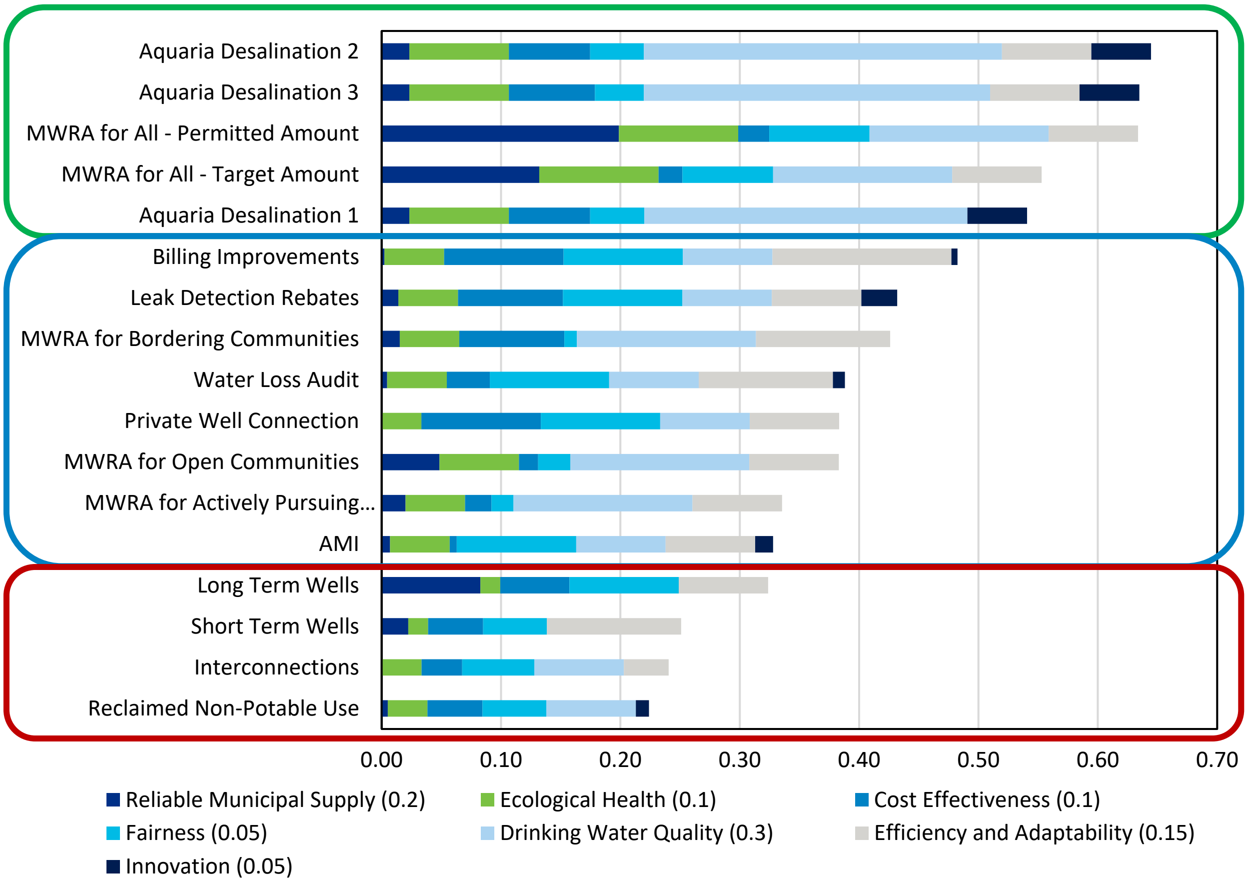


Figure 3 Distribution of Steering Committee's Weightings of the Objectives

Results

The metric scores shown in **Attachment C** were combined with objective weights shown in **10** to develop overall scores for the alternatives using the MCDA method depicted in Figure 2. **Figure 4** illustrates the performance of alternatives using the regional representative weighting of objectives shown in the last column of **Table 4**. Each bar illustrates the alternative's score relative to each objective (shown in separate colors), where the longer the bar the better the performance. The best possible score for each objective using the representative weighting is shown in parentheses in the legend, with a maximum total possible score for each alternative of 1.0. The benefit of MCDA is it not only shows the overall rank score but the trade-offs between objectives. For example, the Aquaria Desalination 2 and 3 have similar scores to MWRA for All – Permitted Amount, but for different reasons. MWRA for All – Permitted Amount excels in Reliable Municipal Supply because it provides the largest yield of new supply, whereas Aquaria Desalination 2 and 3 excel in Drinking Water Quality because they provide an alternative to local PFAS treatment for participating communities and have low long-term water quality risks.

Figure 4 Scores of Alternatives Using Representative Objective Weighting



The green box on Figure 4 highlights alternatives that score in the top tier based on the representative weightings of objectives. All three Aquaria Desalination projects and the MWRA projects with higher yields fall within this category in part because they score well on the Reliable Municipal Supply and Drinking Water Quality objectives, to which stakeholders generally gave high weights and influence. The mid-tier alternatives, shown in the blue box, include the demand management alternatives. Although these alternatives have smaller yields and have low scores on Reliable Municipal Supply, they have among the highest scores for Fairness, as they offer benefits to underserved communities without negative construction impacts, and Efficiency and Adaptability, as they have the flexibility to be scaled. The smaller iterations of the MWRA alternatives also fall in the middle tier as they have lower scores associated with Reliable Municipal Supply, Ecological Health, and Fairness than their higher yield counterparts. Among the lower-tier alternatives are the emergency interconnections and reclaimed non-potable use alternatives as well as both short- and long-term well alternatives. Wells score poorly with respect to the stakeholder defined objectives of Ecological Health, Drinking Water Quality, and Innovation. However, wells may offer benefits not captured in the metrics that continue to make them attractive options to some communities. For example, municipalities will maintain complete control over their water systems and not have any risks associated with blending water from alternative sources.

As there was variation in the objectives that each community viewed as most important, scores were computed individually according to the weightings assigned by each community. The overall scores are summarized in **Table 11**. The scores are color-coded with the higher scoring alternatives in dark green and the lower scoring alternatives in red, with gradations of color in between. The alternatives are listed in order of the scores using the regional representative weightings. Trends in colors of the alternatives show general agreement in which alternatives satisfy the objective most broadly (in green) versus those that do not (in orange/red). This suggests the scoring methodology is not particularly sensitive to the weightings assigned. The desalination and MWRA alternatives with higher yields generally score well, in part due to high scores in the Reliable Municipal Supply and Water Quality objectives, to which communities often assigned higher weights. It can also be noted that the MWRA and desalination alternatives with lower yields, including MWRA for Open Communities (LT-5) and MWRA for Actively Pursuing Communities (LT-6) generally score more poorly than their counterparts with higher yields, suggesting these larger infrastructure projects become more favorable as more communities’ needs are met.

Table 11 Alternative Scores Based on Each Steering Committee Member's Weightings

Alternative		A	B	C	D	E	F	G	H	I	J	K	L	M	N
Aquaria Desalination 2 - West	ST-7	0.50	0.63	0.63	1.00	0.57	0.60	0.58	0.56	0.62	0.63	0.58	0.88	0.76	0.64
Aquaria Desalination 3 - East	ST-8	0.50	0.63	0.63	0.97	0.56	0.60	0.57	0.56	0.62	0.62	0.58	0.87	0.75	0.63
MWRA for All - Permitted Amount	LT-3	0.70	0.58	0.58	0.50	0.68	0.59	0.69	0.63	0.56	0.65	0.63	0.67	0.56	0.80
MWRA for All - Target Amount	LT-4	0.57	0.50	0.51	0.50	0.56	0.49	0.55	0.52	0.46	0.56	0.54	0.67	0.49	0.72
Aquaria Desalination 1 - Mix	ST-6	0.39	0.51	0.54	0.90	0.49	0.50	0.53	0.46	0.52	0.53	0.46	0.80	0.68	0.58
Billing Improvements	ST-4	0.45	0.51	0.60	0.25	0.40	0.50	0.26	0.48	0.50	0.50	0.50	0.42	0.41	0.48
Leak Detection Rebates	ST-2	0.38	0.46	0.53	0.25	0.38	0.44	0.28	0.46	0.43	0.46	0.42	0.40	0.40	0.46
MWRA for Bordering Communities	LT-7	0.37	0.45	0.48	0.50	0.38	0.46	0.34	0.35	0.50	0.41	0.42	0.48	0.46	0.39
Water Loss Audit	ST-1	0.36	0.38	0.42	0.25	0.31	0.34	0.21	0.39	0.31	0.41	0.39	0.40	0.30	0.43
Private Well Connection	LT-1	0.34	0.38	0.50	0.25	0.32	0.40	0.23	0.36	0.40	0.41	0.38	0.31	0.37	0.36
MWRA for Open Communities	LT-5	0.36	0.35	0.34	0.50	0.35	0.34	0.35	0.32	0.33	0.37	0.36	0.53	0.38	0.45
MWRA for Actively Pursuing Communities	LT-6	0.29	0.31	0.31	0.50	0.29	0.30	0.29	0.26	0.30	0.32	0.32	0.47	0.36	0.35
AMI	ST-3	0.30	0.30	0.32	0.25	0.26	0.25	0.19	0.34	0.20	0.36	0.32	0.39	0.25	0.40
Long Term Wells	LT-2	0.39	0.33	0.39	0.00	0.33	0.35	0.26	0.38	0.33	0.36	0.36	0.13	0.23	0.32
Short Term Wells	ST-5	0.28	0.28	0.31	0.00	0.22	0.27	0.12	0.29	0.26	0.26	0.29	0.14	0.16	0.24
Interconnections	LT-8	0.20	0.21	0.26	0.25	0.19	0.22	0.16	0.21	0.20	0.25	0.22	0.28	0.24	0.26
Reclaimed Non-Potable Use	LT-9	0.17	0.21	0.26	0.25	0.20	0.22	0.18	0.20	0.21	0.24	0.20	0.27	0.25	0.25

Note: Cost was included by the Steering Committee as an objective, with a comparatively low weight with respect to the other objectives. **In reality, cost is a constraint, and the formulation of portfolios will not be based on the assumption that just because an alternative ranked high, it is affordable or feasible**. The ranking shown in this table is intended to be used as guidance, supplemented with additional information, and not as a recommendation on its own.

Additional sensitivity runs were completed by examining the lower and upper bounds of the weights assigned to the objectives by the communities. In each run, a different objective was emphasized above all and weights were distributed to the remaining objectives, scaled to the average values from all communities. The weights and resulting scores for these runs are summarized in **Table 12** and **Table 13**, respectively. Assigning equal weights to the objectives resulted in improved rankings for demand-side management strategies, as their lower scores relative to Reliable Municipal Supply and Drinking Water Quality were deemphasized. Sensitivity run 1, emphasizing Water Quality, resulted in similar rankings to the representative weightings because drinking water quality already had a fairly large emphasis on overall score. Sensitivity run 2, emphasizing Ecological Health, also resulted in similar scores as alternatives that score well for Ecological Health align with those that score well for Water Quality. Emphasizing Cost Effectiveness in Sensitivity 3 resulted in higher scores for demand-side management alternatives due to their lower unit cost. If Cost-Effectiveness is removed from scoring, as in Sensitivity 4, the higher yield MWRA and desalination projects perform best due to their higher scores in Reliable Municipal Supply and Drinking Water Quality being increasingly emphasized.

Table 12 Sensitivity Analysis Objective Weightings

	Representative Averages	Equal	Sensitivity 1 – Emphasize Water Quality	Sensitivity 2 – Emphasize Ecological Health	Sensitivity 3 – Emphasize Cost-Effectiveness	Sensitivity 4 – Remove Cost-Effectiveness
Reliable Municipal Supply	20	14.3	20	15	10	25
Ecological Health	10	14.3	10	30	5	10
Cost Effectiveness	10	14.3	10	10	50	0
Innovation	5	14.3	5	5	5	5
Fairness	10	14.3	5	5	5	10
Drinking Water Quality	30	14.3	40	25	20	35
Efficiency & Adaptability	15	14.3	10	10	5	15
Total	**100**	**100**	**100**	**100**	**100**	**100**

Table 13 Alternative Performance Sensitivity Analysis Results

Alternative		Represent-ative	Equal	Sensitivity 1 – Emphasize Water Quality	Sensitivity 2 – Emphasize Ecological Health	Sensitivity 3 – Emphasize Cost-Effectiveness	Sensitivity 4 – Remove Cost-Effectiveness
Aquaria Desalination 2 - West	ST-7	0.64	0.65	0.70	0.71	0.69	0.63
Aquaria Desalination 3 - East	ST-8	0.63	0.65	0.69	0.70	0.70	0.62
MWRA for All - Permitted Amount	LT-3	0.63	0.58	0.62	0.69	0.45	0.68
MWRA for All - Target Amount	LT-4	0.55	0.52	0.54	0.63	0.38	0.59
Aquaria Desalination 1 - Mix	ST-6	0.54	0.57	0.61	0.63	0.65	0.52
Billing Improvements	ST-4	0.48	0.55	0.41	0.47	0.68	0.40
Leak Detection Rebates	ST-2	0.43	0.54	0.38	0.44	0.63	0.36
MWRA for Bordering Communities	LT-7	0.43	0.40	0.43	0.45	0.62	0.37
Water Loss Audit	ST-1	0.39	0.44	0.33	0.39	0.35	0.37
Private Well Connection	LT-1	0.38	0.44	0.33	0.36	0.64	0.30
MWRA for Open Communities	LT-5	0.38	0.33	0.39	0.44	0.28	0.40
MWRA for Actively Pursuing Communities	LT-6	0.34	0.29	0.35	0.37	0.28	0.34
AMI	ST-3	0.33	0.38	0.28	0.34	0.20	0.34
Long Term Wells	LT-2	0.32	0.37	0.25	0.27	0.41	0.29
Short Term Wells	ST-5	0.25	0.29	0.19	0.21	0.31	0.21
Interconnections	LT-8	0.24	0.25	0.22	0.25	0.28	0.22
Reclaimed Non-Potable Use	LT-9	0.22	0.26	0.22	0.25	0.34	0.19

Conclusion

The ranking of alternatives using the MCDA analysis provides objective insight into whether an alternative addresses many stakeholder-defined objectives, a subset of objectives, or none at all. These answers may or may not align with stakeholders' intuitive sense of what alternatives are most preferable. The MCDA analysis is not intended to result in an "answer" or even a prioritized list of recommendations for each community or the region. Rather, these results can be used by project participants to guide and justify current plans, and as a guide for the Standing Committee and OCPC as they prioritize next steps, coordinate with communities, identify opportunities for partnerships, and seek funding for implementation.

Despite the value of the MCDA analysis in showing objective scores, there may be additional constraints not captured in the analysis, such as cost or permitting limitations; additional risks, such as to climate change or regulatory uncertainty; and outside preferences, such as to maintain full control over a local supply. To capture these additional considerations, what is learned from the MCDA analysis will be combined with insights from ongoing interviews with Steering Committee members and an independent risk assessment that considers the risks mitigated by and potential risks associated with execution of the alternative (**Figure 5**). Together these sources of information and analysis will be used to identify or justify short-term strategies for Steering Committee members and to serve as a road map for long-term consideration of investments and adaptation points.

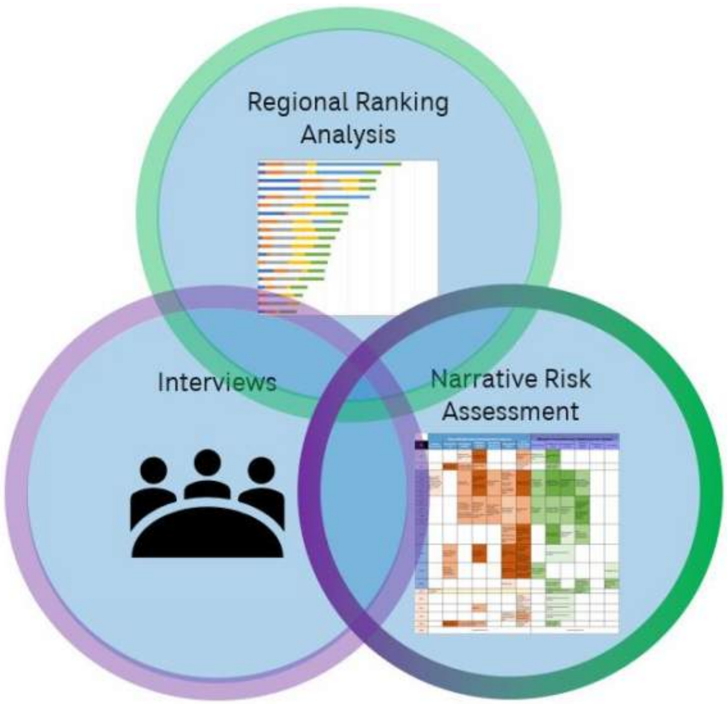


Figure 5 Sources of Information and Analysis Used to Guide Steering Committee Recommendations

References

CDM Smith, 2022. MWRA Water and Wastewater System Expansion Evaluation to South Shore Communities.

CDM Smith, 2024a. Old Colony Planning Council Regional Water Plan – Water Demand Projection.

CDM Smith, 2024b. Old Colony Planning Council Regional Water Plan: Annotated Bibliography.

Attachments

Attachment A – Fact Sheets on Alternatives

Attachment B – Fact Sheets on Best Practice Recommendations

Attachment C – Scorecard

Appendix F Meeting Summaries (Steering Committee Workshops and Public Meetings)

Appendix F
Meeting Summaries

Appendix F
Steering Committee Meeting 1
01-29-2024

OLD COLONY PLANNING COUNCIL

Rebecca Coletta, President | Mary Waldron, Executive Director

(508) 583-1833 | 70 School Street, Brockton, MA 02301 | www.oldcolonyplanning.org

Regional Water Plan
Steering Committee Meeting
MINUTES OF THE MEETING
Monday, January 29, 2024, 10:00am

Location: Old Colony Planning Council, 70 School St, Brockton, MA 02301

Attendees:

Steering Committee	
Organization	**Name**
Town of Avon	Jonathan Beder
Town of Bridgewater	Bob Rulli
Bridgewater Engineering	Peter Gordon
City of Brockton	Patrick Hill
CPCWDC	Art Egerton
CPCWDC	Kimberly Groff
East Bridgewater	John Haines
Easton Department of Public Works	Greg Swan
MA Department of Conservation and Recreation	Jason Duff
Pembroke Water Department	Dan Sullivan
Plymouth DPW Water Division	Peter Gordon
Town of Plympton	Brian Vasa
Senator Mike Brady's Office	Karla Kahale (via Zoom)
South Shore Chamber of Commerce	Peter Forman (via Zoom)
Stoughton Water & Sewer Department	Philip A. McNulty
West Bridgewater Water Department	Wayne Parks
Town of Whitman	Noreen O'Toole
U.S. EPA Region 1	Margherita Pryor
Watershed Associations	Pine duBois

Observers	
Organization	**Name**
MAPC	Martin Pillsbury (via Zoom)

OCPC	Bill Napolitano
OCPC	Don Sullivan
OCPC	Mary Waldron
OCPC	Joanne Zygmunt

Consultants	
Organization	**Name**
CDM Smith	Tarun Gill
CDM Smith	Amara Regehr
CDM Smith	Kara Rozycki
CDM Smith	Kirk Westphal
Regina Villa Associates	Keith Sonia
Regina Villa Associates	Kyle Olsen

Minutes:

1. Call to Order

2. Old Colony Planning Council Overview

    a. Introduction to Regional Water Plan Project provided by OCPC

    b. Funding partners provided: U.S. Economic Development Administration (EDA), Central Plymouth County Water District Commission (CPCWDC), South Shore Chamber of Commerce, State of Massachusetts Economic Development Earmark, Narragansett Bay Estuaries Program, CDM Smith R&D

3. Introductions

    a. CDM Smith team introduced, along with subconsultants: Alliance for Water Efficiency, Regina Villa Associates (RVA, present), and UMass Amherst

    b. Stakeholder introductions

    c. Review of CDM Smith and RVA Team qualifications. Joanne to distribute CDM Smith proposal to Steering Committee.

4. Orientation to the Planning Process

    a. Overview of 12 meetings anticipated throughout the project duration

        i. Meeting 1: Introductions/Process
        Meeting 2: Perspectives and Opportunities
        Workshop 1: Consensus Building Process
        Workshop 2: Objectives
        Workshop 3: Performance Metrics
        Workshop 4: Water Supply Alternatives: Local, Regional, External
        Workshop 5: Comparison of Alternatives

Workshop 6: Short-Term and Long-Term Supply Portfolios
Workshop 7: Adaptation and Implementation Planning
Meeting 3: Draft Plan
Meeting 4: Implementation Strategy and Priorities
Meeting 5: Final Plan

ii. Goal is to have a tangible product to have a plan and be able to apply for future grants/next steps to implementation.

b. Review of project roadmap

   i. Example project provided from Regional Water Project in Florida

   ii. Technical work in project scope has some flexibility based on the needs outlined during the project. Technical experts in particular areas can attend meetings as necessary.

   iii. Metrics for assessments will be qualitative and quantitative.

   iv. Alternatives will not be discussed until Workshop 4.

   v. Solution will not be the same in each community.

   vi. Question regarding reuse as an alternative. Everything is on the table. MassDEP reviewing regulatory framework for indirect and direct potable reuse. Comment that non-potable reuse exists at Gillette, Wrentham Outlets, golf course irrigation, and other locations in MA.

   vii. Discussed importance of adaptive planning. Example project in Texas reviewed project every five years to reassess how plan is performing.

   viii. Discussion of new MBTA housing requirement. Demand is there, but communities are water stressed to meet current demands. Concerns that state interests are conflicting.

   ix. Public input on the project will include two public meetings and other outreach (website, email, etc.)

   x. Regulatory hurdles, permitting, and feasibility will be considered in alternative assessments.

   xi. Request to bring in additional folks to stakeholder meetings: Department of Marine Fisheries, MassDEP, State Legislators. Any other requests can be sent to Joanne.

   xii. Pace of project will be different for everyone. Team asks that everyone respect the process over the next 12 months.

5. Roles and Responsibilities

   a. CDM Smith and subconsultants are not advocating. Here for facilitation and to provide technical support.

b. Steering Committee roles and responsibilities were provided in Terms of Reference handout.

c. Public Comment roles and responsibilities – 10-15 minutes at each meeting. Steering Committee can decide how to address questions.

d. Public Outreach: Overview of Plan by RVA. Will include public meetings, interviews, education, and more. Languages will be available.

e. Overview of data needs for project. Amara will be distributing individual data requests to each stakeholder to upload to a shared site.

   i. Add Capital Plans to request list

   ii. Files can stay confidential if requested by community

6. Concept of Consensus or Agreement

   a. CDM Smith reviewed MVPs, and there is already some shared consensus on water issues: availability of water during droughts, economic development/water quantity, PFAS, algae blooms, saltwater intrusion. This Regional Water Plan process will continue to identify individual and regional interests.

7. Discussion and List of Issues to Address

   – Balance between demand and finding the resource
   – Water quality, PFAS, Iron/Manganese. Towns don't always have the ability to upgrade facilities
   – Regional benefits
   – Management choices effect on environment to understand devastation
   – Maintaining water quantity and being a good water neighbor. Compatibility considerations
   – Learn local issues to support regional priorities and solutions. State tries to not be a barrier.
   – Being prepared for future, putting tools in toolbox now
   – Sustainable water supply, regulatory issues, timing, concern with using funds appropriately
   – Getting political buy-in
   – Silver Lake, Integrated issues and vulnerabilities, quality and quantity
   – Costs, regulatory approval, environmental protection
   – Public outreach to educate citizens on well issues
   – Working regionally to supply and protect water resources
   – Regional support and development choices
   – Affordability
   – Support between regional agencies
   – Climate/drought, regulations, infrastructure, keeping up with capital projects, staffing
   – MBTA housing requirement
   – Land Use Planning, Resource protection

8. Schedule for Future Meetings
    a. Meeting invitations will be distributed via email.
    b. Requested that each community have a representative at every meeting.
9. Public Comment
    a. None

Action Items:

Assigned to	Action Item
Joanne	Distribute Proposal
Amara	E-mail data requests
Kara	E-mail meeting invitations
All	Provide requested data
Kara	Distribute slides and meeting summary
Joanne	Invite additional stakeholders to future meetings: DMF, MassDEP, and any others requested

Attachments:

1. Meeting Presentation Slides
2. Terms of Reference
3. Example Data Request
4. Meeting Sign-In Sheet

Prepared by CDM Smith.

ATTACHMENT 1
MEETING PRESENTATION SLIDES

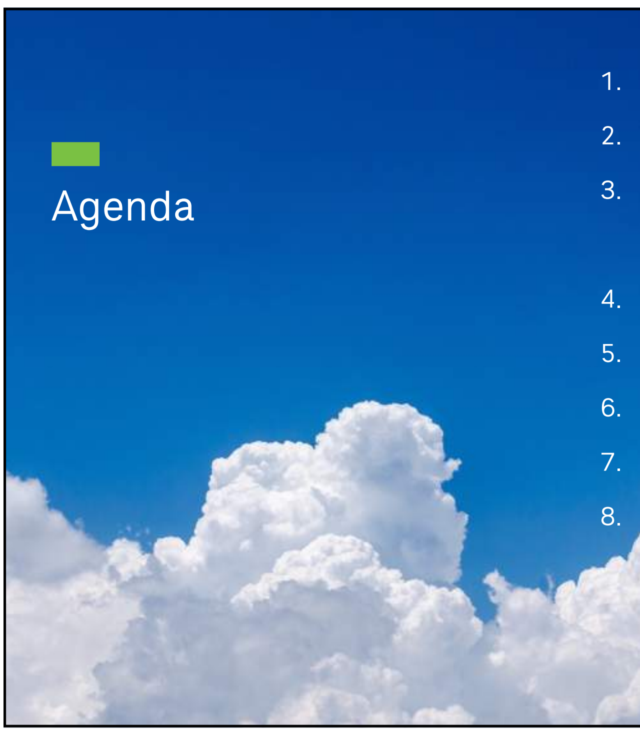
Old Colony Planning Council Regional Water Plan

Economic Resilience and Sustainable Water Supply

Kirk Westphal, Kara Rozycki, Tarun Gill, and Amara Regehr

January 29, 2023

1



Agenda

1. Old Colony Planning Council Overview
2. Introductions
3. Orientation to the Planning Process

   Coffee Break

4. Roles and Responsibilities
5. Concept of Consensus or Agreement
6. Discussion and List of Issues to Address
7. Schedule for Future Meetings
8. Public Comment (last 15 minutes)

OCPC Regional Water Plan 2

2

Old Colony Planning Council Overview

3

Introductions

4

Introductions

- Name
- Community or organization you are representing
- Position/Title

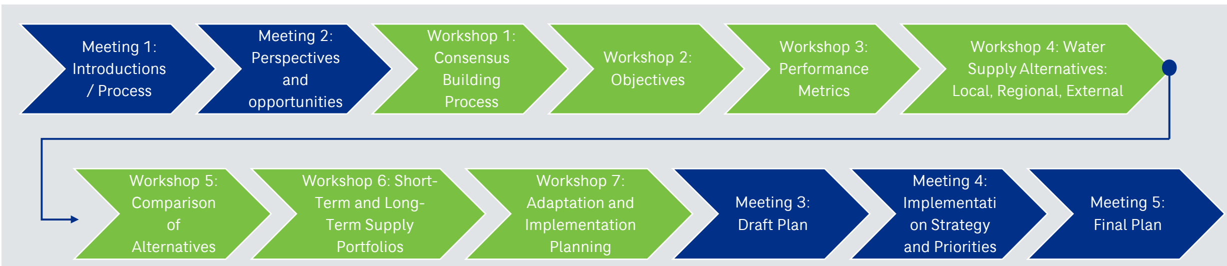
5

5

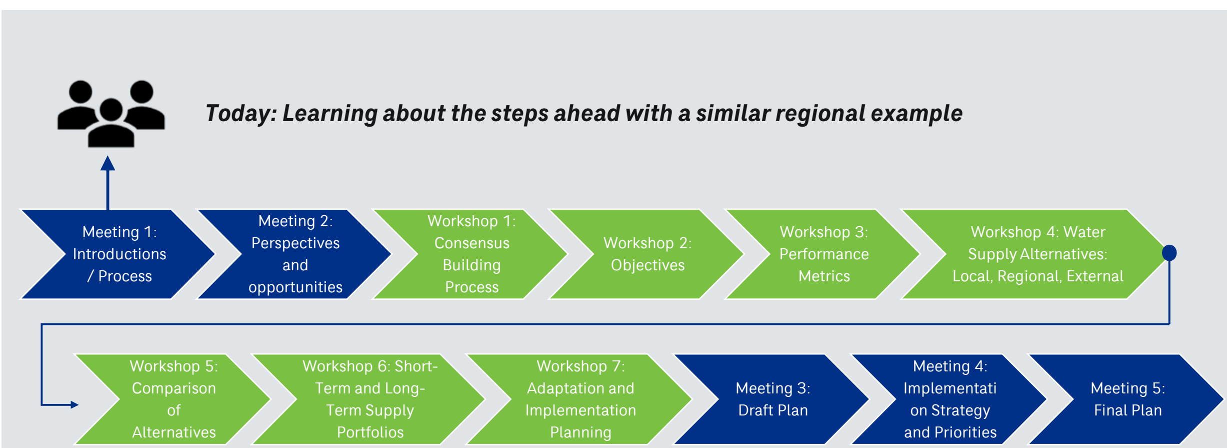
Orientation to the Planning Process

6

Steering Committee Engagement



Steering Committee Engagement



Project Roadmap

Steering Committee Engagement

Workshop 1: Intros/Process
Workshop 2: Objectives
Workshop 3: Metrics
Workshop 4: Alternatives
Workshop 5: Comparison
Workshop 6: Portfolios
Workshop 7: Adaptive Plan

Objectives	Objective Weight
Deliver Utility System Reliability	30%
Provide Cost-Effective Solutions	25%
Protect the Natural Environment	25%
Maximize Implementation	15%
Offer Community Benefits	5%

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Project Roadmap

Steering Committee Engagement

Workshop 1: Intros/Process
Workshop 2: Objectives
Workshop 3: Metrics
Workshop 4: Alternatives
Workshop 5: Comparison
Workshop 6: Portfolios
Workshop 7: Adaptive Plan

Objectives	Objective Weight	Metric
Deliver Utility System Reliability	30%	Supply shortages
Provide Cost-Effective Solutions	25%	Total levelized unit cost and total capital costs
Protect the Natural Environment	25%	Net aquifer withdrawal over planning period and total sustainable sources
Maximize Implementation	15%	Stakeholder acceptance, permitting ease and operational ease
Offer Community Benefits	5%	Leading edge solutions and co-benefits

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Project Roadmap

Steering Committee Engagement

Workshop 1: Intros/Process → Workshop 2: Objectives → Workshop 3: Metrics → Workshop 4: Alternatives → Workshop 5: Comparison → Workshop 6: Portfolios → Workshop 7: Adaptive Plan

DEMAND ALTERNATIVES
Single-family Toilet Rebate
New Development Turf Reduction
Reclaimed Water Rate Adjustment
Advanced Metering Infrastructure

SUPPLY ALTERNATIVES	WATER TYPE
Floridan Aquifer Additional Supply	Either
Surface Water (High-Yield)	Potable
DOT Stormwater Augmentation (Local Treatment)	Reclaimed
Reclaimed Storage Ponds	Reclaimed

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Project Roadmap

Steering Committee Engagement

Workshop 1: Intros/Process → Workshop 2: Objectives → Workshop 3: Metrics → Workshop 4: Alternatives → Workshop 5: Comparison → Workshop 6: Portfolios → Workshop 7: Adaptive Plan

DEMAND ALTERNATIVE	Assumed Participants	Water Type	Lifespan (Years)	Total Savings (MG)	Total Cost ($/ 1,000 gallons)
Single-family Toilet Rebate	5,000	Potable	20	774	**$0.97**
New Development Turf Reduction	26,682	Reclaimed	22	7,329	**$0.030**
Reclaimed Water Rate Adjustment	All	Reclaimed	22	24,630	**$0.009**
Advanced Metering Infrastructure	All	Potable	24	7,211	**$0.37**

SUPPLY ALTERNATIVE	Yield (MGD)	Water Type	Capital ($M)	O&M ($M)	$ / 1000 gallon s
Floridan Aquifer Additional Supply	1	Potable/ Reclaimed	$500,000	$0	**$0.05**
Surface Water (High-Yield)	5	Potable	$101,860,000	$3,641,000	**$3.86**
DOT Stormwater Augmentation (Local Treatment)	3.6	Reclaimed	$95,608,000	$613,0000	**$2.89**
Reclaimed Storage Ponds	1	Reclaimed	$32,000,000	$100,000	**$3.20**

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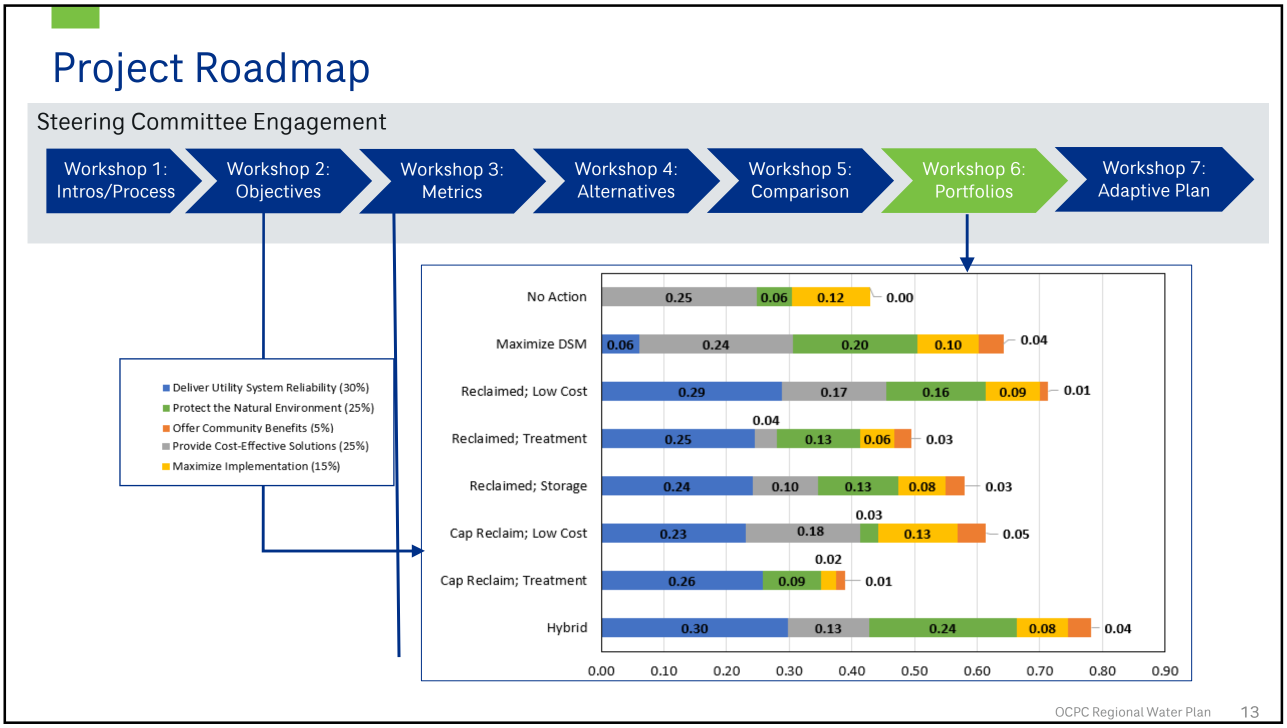
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Workshop 1: Intros/Process
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Workshop 5: Comparison
Workshop 6: Portfolios
Workshop 7: Adaptive Plan
Deliver Utility System Reliability (30%)
Protect the Natural Environment (25%)
Offer Community Benefits (5%)
Provide Cost-Effective Solutions (25%)
Maximize Implementation (15%)
No Action 0.25 0.06 0.12 0.00
Maximize DSM 0.06 0.24 0.20 0.10 0.04
Reclaimed; Low Cost 0.29 0.17 0.16 0.09 0.01
Reclaimed; Treatment 0.25 0.04 0.13 0.06 0.03
Reclaimed; Storage 0.24 0.10 0.13 0.08 0.03
Cap Reclaim; Low Cost 0.23 0.18 0.03 0.13 0.05
Cap Reclaim; Treatment 0.26 0.09 0.02 0.01
Hybrid 0.30 0.13 0.24 0.08 0.04
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90
OCPC Regional Water Plan 13

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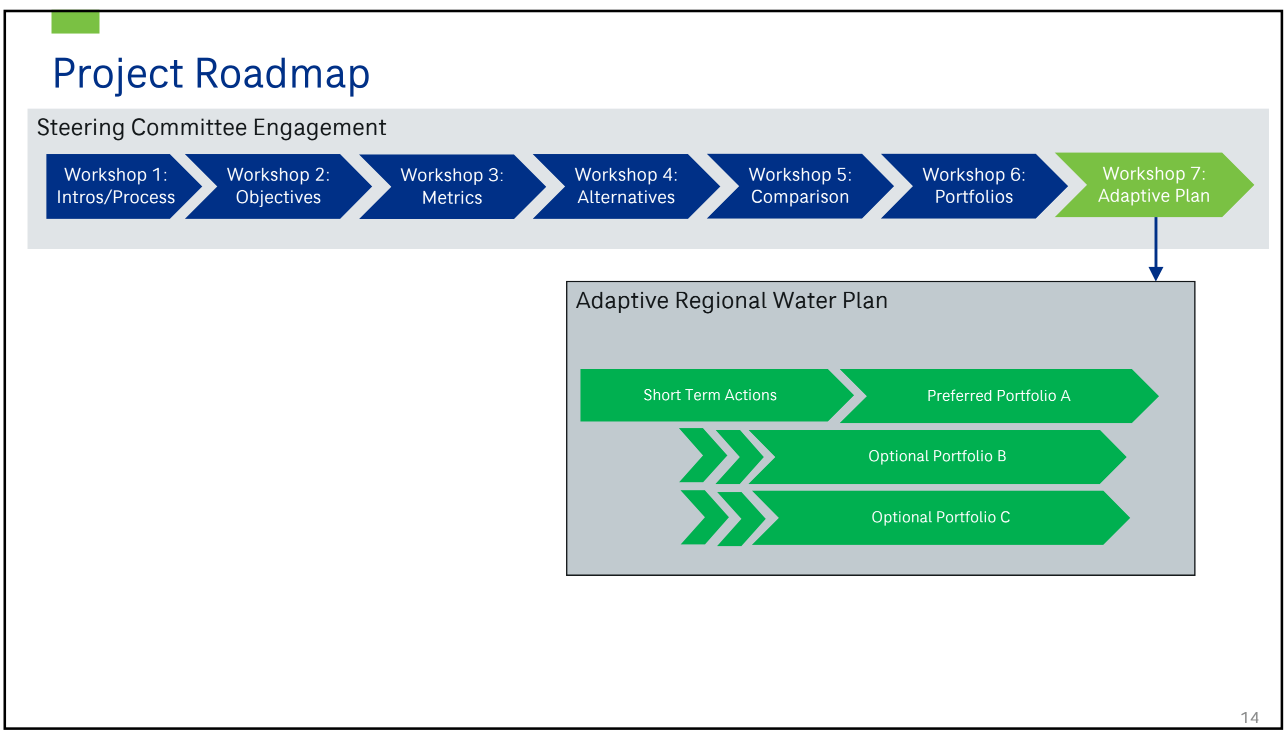
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Workshop 7: Adaptive Plan
Adaptive Regional Water Plan
Short Term Actions
Preferred Portfolio A
Optional Portfolio B
Optional Portfolio C
14

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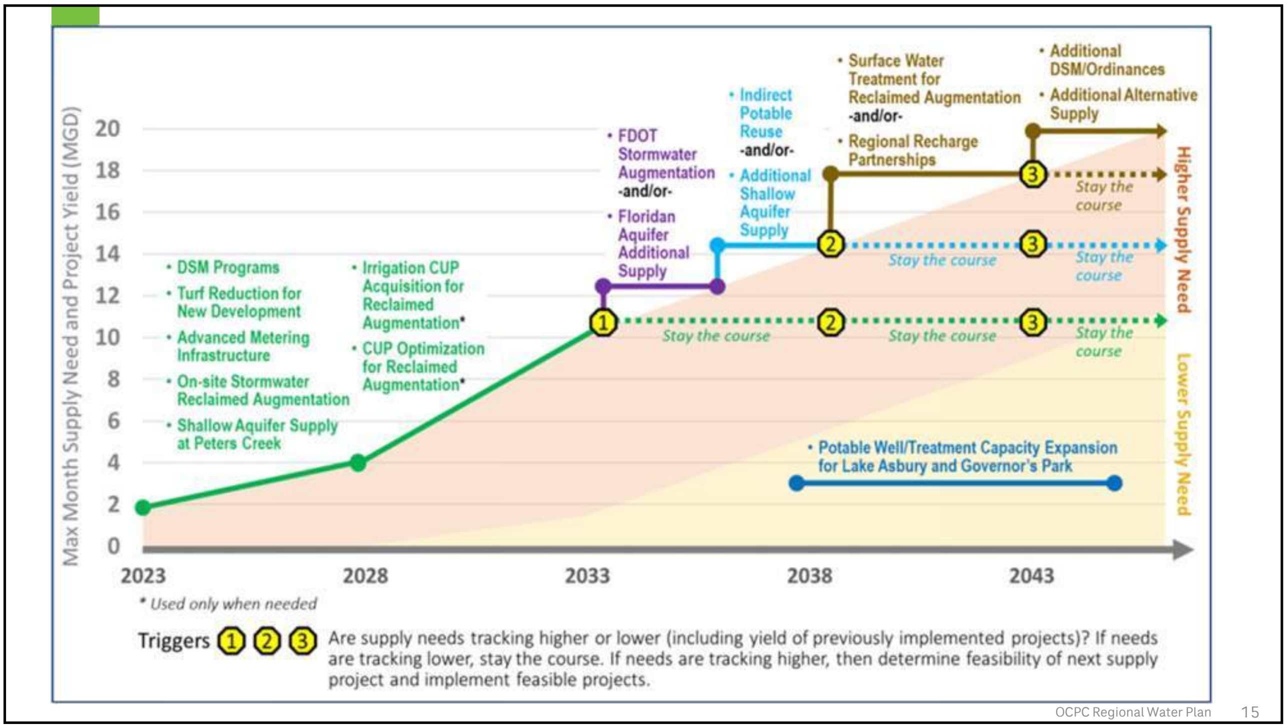

Max Month Supply Need and Project Yield (MGD)
20
18
16
14
12
10
8
6
4
2
0
2023
2028
2033
2038
2043
• DSM Programs
• Turf Reduction for New Development
• Advanced Metering Infrastructure
• On-site Stormwater Reclaimed Augmentation
• Shallow Aquifer Supply at Peters Creek
• Irrigation CUP Acquisition for Reclaimed Augmentation*
• CUP Optimization for Reclaimed Augmentation*
• FDOT Stormwater Augmentation -and/or-
• Floridan Aquifer Additional Supply
• Indirect Potable Reuse -and/or-
• Additional Shallow Aquifer Supply
• Surface Water Treatment for Reclaimed Augmentation -and/or-
• Regional Recharge Partnerships
• Additional DSM/Ordinances
• Additional Alternative Supply
Stay the course
Stay the course
Stay the course
Stay the course
Stay the course
Stay the course
Stay the course
• Potable Well/Treatment Capacity Expansion for Lake Asbury and Governor's Park
Higher Supply Need
Lower Supply Need
* Used only when needed
Triggers 1 2 3 Are supply needs tracking higher or lower (including yield of previously implemented projects)? If needs are tracking lower, stay the course. If needs are tracking higher, then determine feasibility of next supply project and implement feasible projects.
OCPC Regional Water Plan 15

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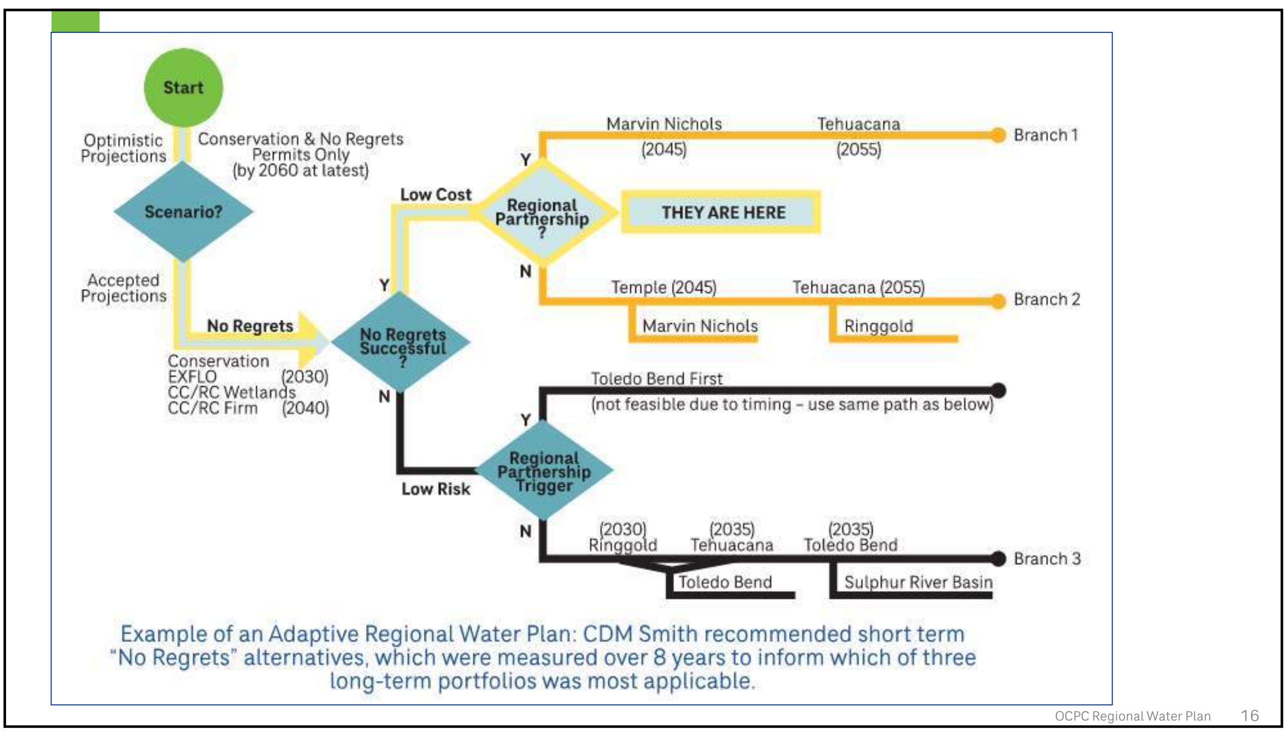

Start
Optimistic Projections
Conservation & No Regrets Permits Only (by 2060 at latest)
Scenario?
Accepted Projections
No Regrets
Conservation
EXFLO (2030)
CC/RC Wetlands
CC/RC Firm (2040)
Low Cost
Y
No Regrets Successful ?
N
Low Risk
Regional Partnership ?
THEY ARE HERE
Marvin Nichols (2045)
Tehuacana (2055)
Branch 1
Temple (2045)
Tehuacana (2055)
Marvin Nichols
Ringgold
Branch 2
Toledo Bend First
(not feasible due to timing – use same path as below)
Regional Partnership Trigger
(2030) Ringgold
(2035) Tehuacana
(2035) Toledo Bend
Toledo Bend
Sulphur River Basin
Branch 3
Example of an Adaptive Regional Water Plan: CDM Smith recommended short term "No Regrets" alternatives, which were measured over 8 years to inform which of three long-term portfolios was most applicable.
OCPC Regional Water Plan 16

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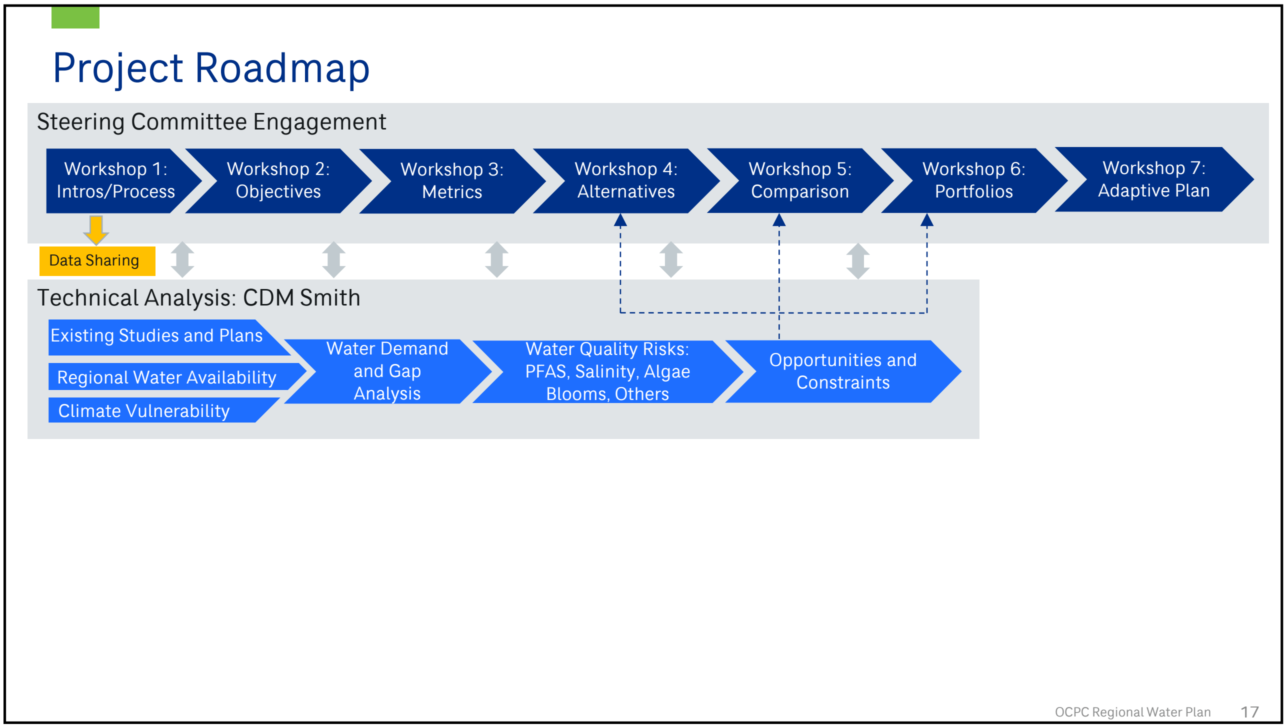
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Workshop 5: Comparison
Workshop 6: Portfolios
Workshop 7: Adaptive Plan
Data Sharing
Technical Analysis: CDM Smith
Existing Studies and Plans
Regional Water Availability
Climate Vulnerability
Water Demand and Gap Analysis
Water Quality Risks: PFAS, Salinity, Algae Blooms, Others
Opportunities and Constraints
OCPC Regional Water Plan 17

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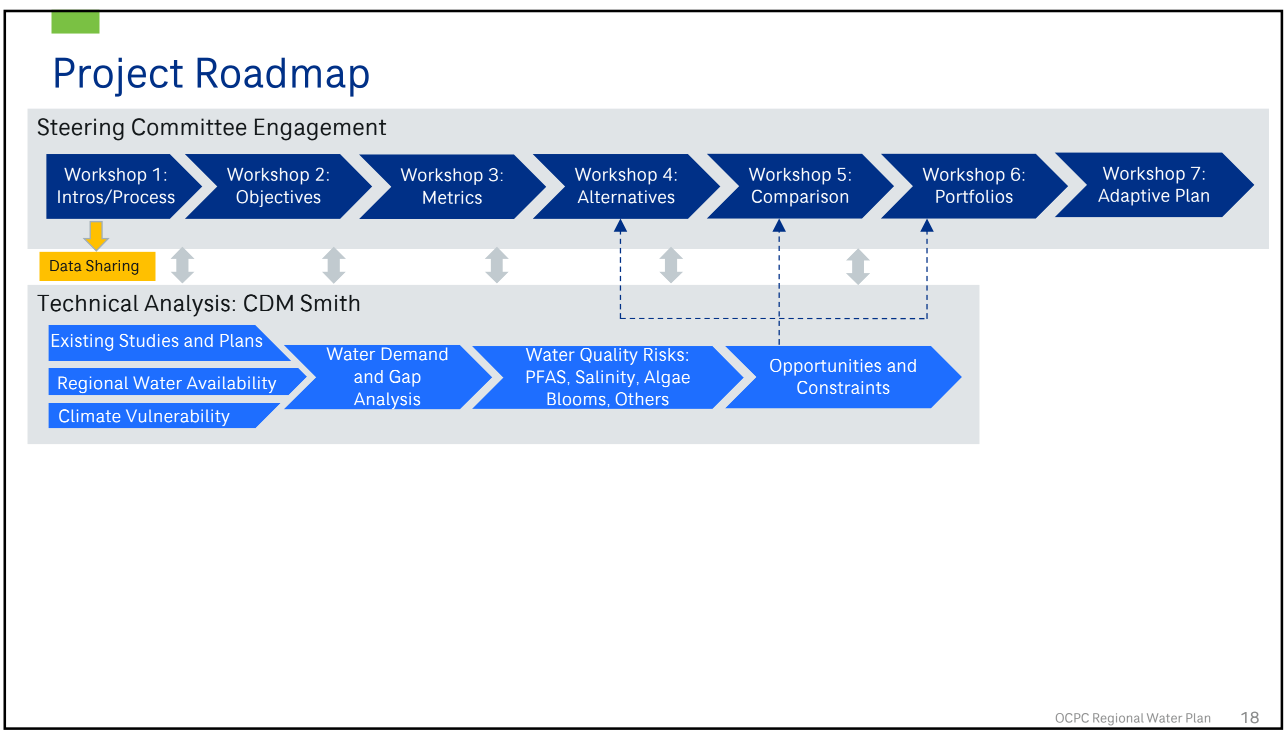
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OCPC Regional Water Plan 18

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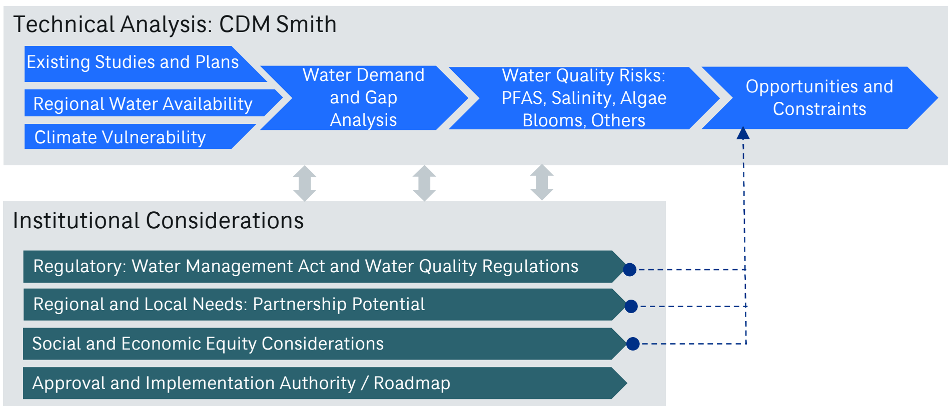
Project Roadmap



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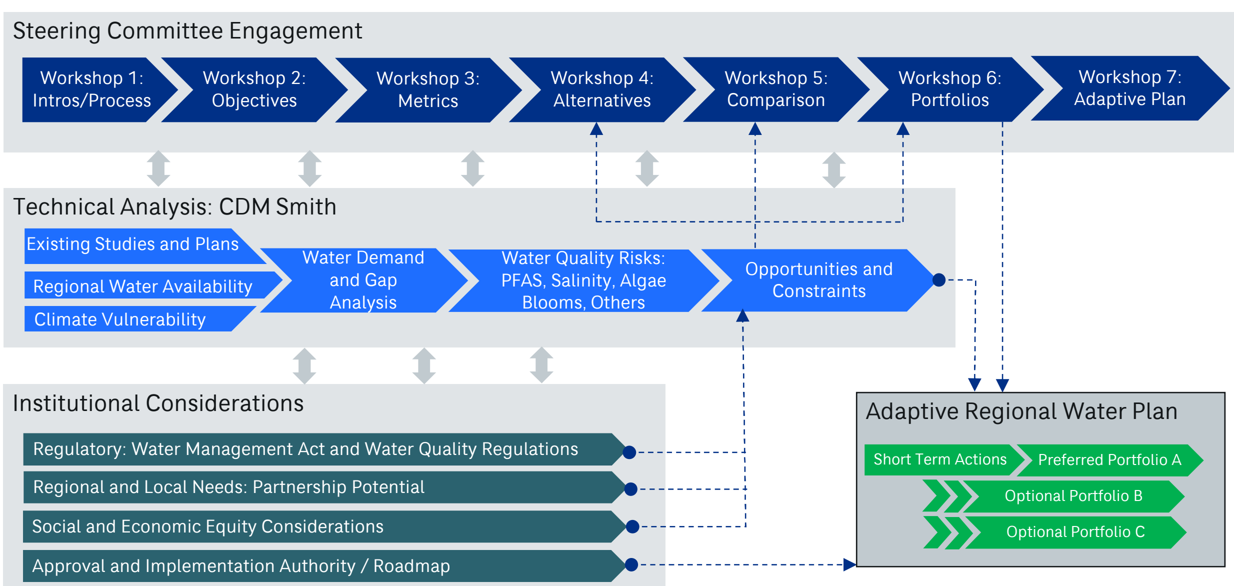
Project Roadmap



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Pacing of the Project

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Coffee Break

22

Roles and Responsibilities

23

CDM Smith Roles and Responsibilities

- Facilitate discussion to reach agreement on a path forward
- Provide technical information that will support that process

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Steering Committee Roles and Responsibilities

- Represent your own organization
- Facilitate sharing of project related knowledge in a timely fashion
- Make every effort to attend the monthly Steering Committee meetings and workshops in person
- Support the decision-making process by making recommendations
  - Funding or policy decisions are not required at this time
- Respect interests and perspectives of all other participants
- Coordinate with stakeholders to provide feedback on deliverables (Draft Plan, Final Plan) in a timely fashion
- Members representing multiple organizations will meet regularly with these groups to share progress and facilitate sharing of project related knowledge

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Steering Committee Roles and Responsibilities

Refer to the Terms of Reference

26

Public Comment Roles and Responsibilities

- We will dedicate a 10–15-minute period during each meeting for members of the public to offer inputs.
- Input may include comments, concerns, or questions.
- It will be up to the Steering Committee on how and whether to address questions during the regular meeting.
- Only Steering Committee members will participate in deliberations and the formal process of developing recommendations
- Please participate in these meetings and offer your perspectives, because they will help shape the outcome and you are very welcome to be with us throughout.

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Public Outreach

- Inclusive and accessible outreach
- Public Meetings
- Targeted interviews to guide plan development
- Education

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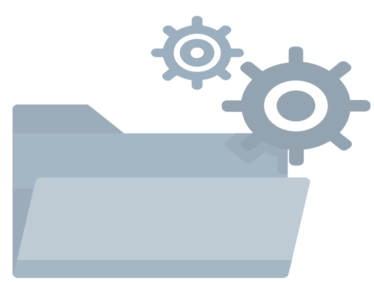
Community Specific Data Requests

- Transmit important documents preferable by February 5th (**one week**)
  - Water master plans a priority
- Representing multiple communities? Please facilitate transmittal from these communities
- Email from Amara Regehr with a link to a private online folder for file uploads
  - If any data is confidential, have the name of the document start with "CONFIDENTIAL_"

Community Specific Data Requests

- Table 1: Reports and data to be transmitted to CDM Smith
  - **This is a comprehensive list, some reports may not be relevant for you community/organization**
- Table 2: Publicly available reports
  - We do not need these reports to be transmitted but may have questions on specifics mentioned within them.



Concept of Consensus or Agreement

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Municipal Vulnerability Plans

Inland Flooding

Severe Storms

Drought

Extreme Temperatures

High Winds

Many shared future climate hazards

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Municipal Vulnerability Plans

- **Water Quantity**
  - Availability during droughts
  - Economic development
- **Water Quality**
  - PFAS
  - Harmful Algae Blooms
  - Saltwater Intrusion

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Discussion

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Discussion

- In a minute:
  - What do you see are the most important issues for us to address?

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Upcoming schedule

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Upcoming Schedule

WHEN	DETAILS
Monday, February 5	Upload requested documents to personalized SharePoint site
Wednesday, February 28th 10:00 am – 12:00 pm	Meeting 2: Sharing of perspectives and opportunities
Tuesday, March 19th 9:00 am – 12:00 pm	Workshop 1: Overview of Consensus Building Process and Variations with Examples
Tuesday, April 23rd 9:00 am – 12:00 pm	Workshop 2: Objectives
Tuesday, May 21st 9:00 am – 12:00 pm	Workshop 3: Performance Metrics
Tuesday, June 25th 9:00 am – 12:00 pm	Workshop 4: Water Supply Alternatives: Local, Regional, External
Wednesday July 31st 9:00 am – 12:00 pm	Workshop 5: Comparison of Alternatives (Multicriteria Decision Analysis)
Tuesday, August 27th 9:00 am – 12:00 pm	Workshop 6: Short-Term and Long-Term Supply Portfolios
Tuesday, September 24th 9:00 am – 12:00 pm	Workshop 7: Adaptation and Implementation Planning
Tuesday, October 29th 10:00 am – 12:00 pm	Meeting 3: Draft Plan
Tuesday, November 19th 8:00 am – 12:00 pm	Meeting 4: Implementation Strategy and Priorities
Tuesday, December 10th 8:00 am – 12:00 pm	Meeting 5: Final Plan

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ATTACHMENT 2
OCPC REGIONAL WATER STUDY
STEERING COMMITTEE
GROUP TERMS

OLD COLONY PLANNING COUNCIL

REGIONAL WATER STUDY PROJECT STEERING COMITTEE
Terms of Reference

These Terms of Reference shall not contradict the current policies or procedures of Old Colony Planning Council (OCPC) or any grant award contract between the U.S. Economic Development Administration (EDA) and OCPC.

Background

In 2023, OCPC was awarded a $940,000 investment from the EDA for a regional water study. This application was made possible through an Environmental Protection Agency grant subaward that OCPC received from the Narragansett Bay Estuary Program. The project is being funded under EDA's FY 2020 Public Works and Economic Adjustment Assistance Notice of Funding Opportunity (FY20 PWEAA NOFO). Matching funds were provided by our partners, the Central Plymouth County Water District Commission ($225,000), the Commonwealth ($200,000), and the South Shore Chamber of Commerce/South Shore Economic Development Corporation ($45,000).

The formal name of this project is *Economic Resilience and Sustainable Water Supply in the Old Colony Economic Development District*, or *OCPC Regional Water Study* for short. The project area is the region serviced by OCPC, which is also an EDA-designated Economic Development District: Abington, Avon, Bridgewater, Brockton, Duxbury, East Bridgewater, Easton, Halifax, Hanover, Hanson, Kingston, Pembroke, Plymouth, Plympton, Stoughton, West Bridgewater, and Whitman.

The Project Steering Committee will support this project through collaboration across the region and co-designing the project as it develops to ensure the needs of the region are met.

Purpose and Powers of the Project Steering Committee

The Project Steering Committee's primary purpose is to contribute to the development of a Regional Water Study for the region serviced by OCPC. Steering Committee members will facilitate the sharing of project related knowledge, reports and data with CDM Smith in a timely fashion. Steering Committee members role will be to represent their own organization, as well as other partner organizations with shared interests. They will make every effort to attend the monthly Steering Committee meetings and workshops in person. CDM Smith will work with OCPC to prepare adaptive short-term and long-term portfolios of supply options based on Steering Committee workshop outcomes. Steering Committee members will support in the decision-making process for development of these short-term and long-term project portfolios for inclusion in the Regional Water Plan. Steering Committee members role in decision making will be to make recommendations, but not funding or policy decisions at this time. Every effort will be made to reach consensus in decision-making; when this is not possible, final documentation will summarize all opinions, with attribution if requested. Steering Committee members will respect the interests and perspectives of all other participants. Steering Committee members will coordinate with stakeholders to provide feedback on deliverables for the Regional Water Plan in a timely fashion.

Steering Committee members that are representing multiple communities or groups will meet regularly with their communities to share progress and facilitate the sharing of project- related knowledge and information with CDM Smith and OCPC.

Project Overview

This project will strengthen the region's competitive economic resilience and produce a sustainable water resources supply plan for the long-term development of the region. Tasks to be completed include the following:

1. Project management and grant administration – OCPC will manage the consultant(s), ensure grant requirements are met, and facilitate stakeholder communication across the region
2. Steering Committee – OCPC will form a Project Steering Committee with CDM Smith.
3. CDM Smith will be expected to do the following:
    a. Facilitate the Project Steering Committee
    b. Engage stakeholders and the public across the region
    c. Compile into a library and review all relevant local, regional, state, and federal reports and other materials relevant to the project
    d. Establish a baseline of water use at the municipal and regional levels, making that information available online
    e. Review or establish projections for future (25-years plus) water use at the municipal and regional levels, making clear how much demand is expected to be residential versus other uses, making that information available online
    f. Analyze future water supply demand gaps and recommend solutions for addressing those gaps; solutions explored will include traditional infrastructure supply side options, innovative options such as decentralized systems and water reuse, and demand side measures such as water conservation.
    g. Solutions shall be examined for their economic, social, and environmental costs and benefits
    h. Examine how the most beneficial solutions will lead toward plentiful, affordable, and ecologically sustainable waters supplies for the region
    i. Produce a final report with implementation plan

The outcomes of this project are expected to be the following:

1. A standing Water Resources Committee that continues to collaborate and advise on issues within OCPC's region
2. An implementable plan for economically resilient and ecologically sustainable water supply in the region
3. Priority projects ready for further development and financing
4. Online hub of resources including data sets, maps, and good practices.

Project Steering Committee Process and Meetings

To move this important regional project along expeditiously and ensure grant deadlines are met, it is crucial to have an RFP Advisory Group structure that is manageable and that ensures key informants and stakeholders in the region have opportunity to participate. To that end, the following process has been developed:

WHEN	OCPC	PROJECT STEERING COMMITTEE MEMBERS	CDM Smith	NOTE
2023				
Tuesday, November 28			Contract start date for CDM Smith	Steering Committee formed shortly after
2024				
Monday, January 29 10:00 am– 12:00 pm		Meeting 1: Introduction of members and overview of the planning process		
Monday, February 5		Upload requested documents to personalized SharePoint site		CDM Smith will send an email on 1/29 with the link for the SharePoint.
Wednesday, February 28 10:00 am – 12:00 pm		Meeting 2: Sharing of perspectives and opportunities		
Tuesday, March 19 9:00 am – 12:00 pm		Workshop 1: Overview of Consensus Building Process and Variations with Examples		
Tuesday, April 23 9:00 am – 12:00 pm		Workshop 2: Objectives		
Tuesday, May 21 9:00 am – 12:00 pm		Workshop 3: Performance Metrics		
Tuesday, June 25 9:00 am – 12:00 pm		Workshop 4: Water Supply Alternatives: Local, Regional, External		
Wednesday July 31 9:00 am – 12:00 pm		Workshop 5: Comparison of Alternatives (Multicriteria Decision Analysis)		
Tuesday, August 27 9:00 am – 12:00 pm		Workshop 6: Short-Term and Long-Term Supply Portfolios		
Tuesday, September 24 9:00 am – 12:00 pm		Workshop 7: Adaptation and Implementation Planning		
Tuesday, October 29 10:00 am – 12:00 pm		Meeting 3: Draft Plan		

WHEN	OCPC	PROJECT STEERING COMMITTEE MEMBERS	CDM Smith	NOTE
Tuesday, November 19 8:00 am – 12:00 pm		Meeting 4: Implementation Strategy and Priorities		
Tuesday, December 10 8:00 am – 12:00 pm		Meeting 5: Final Plan		
Tuesday, December 17			CDM Smith issues final Report	Steering Committee dissolves
Wednesday, December 18	Standing Water Resources Committee established for the region			
2025				
Thursday, May 1, 2025	Grant award ends			Grant is 24 months

Project Steering Committee Members

Project Steering Committee Members are invited by OCPC to join. OCPC selected members based on their professional knowledge and experience of water supply issues and their ability to serve as representatives and ambassadors for key stakeholder groups in the region.

Project Lead – OCPC

1. Don Sullivan, Economic Development Director
2. Bill Napolitano, Planner, Comprehensive Planning and Sustainability
3. Joanne Zygmunt, Senior Planner, Comprehensive Planning and Sustainability

Project match funders or their representatives

4. Central Plymouth County Water District Commission- Art Egerton Commissioner, Jack O'Leary Chair, Kimberly Groff Advisor
5. Senator Michael D. Brady, Second Plymouth and Norfolk
    - Representing federal and state legislators in the region
6. Peter Forman, President and CEO, South Shore Chamber of Commerce
    - Representing chambers of commerce in the region

Stakeholder groups or their representatives

7. Pine Dubois, Executive Director, Jones River Watershed Association
    - Representing watershed associations in the region

Municipalities – chief executive officers, public works commissioners, or their representatives

8. Abington – Liz Shea (Town Planner) and Scott Lambiase (Town Manager)
9. Avon – Jonathan Beder (Town Administrator)
10. Bridgewater- Robert Rulli (Community Economic Development Director)
11. Brockton – Pat Hill (Department of Public Works Commissioner)
12. Duxbury – Sheila Sgarzi (Director of Public Works)
13. East Bridgewater –John Haines (Director of Public Works)
14. Easton – Greg Swan (Deputy Director of Public Works)
15. Halifax
16. Hanover – Rhonda Nyman (Hanover Select Board)
17. Hanson
18. Kingston – Keith Hickey (Town Administrator)
19. Pembroke
20. Plymouth
21. Plympton – Brian Vasa (Conservation Agent)
22. Stoughton – Phil McNulty (Water/ Sewer Superintendent)
23. West Bridgewater – Wayne Parks (Water Superintendent)
24. Whitman

Project Steering Committee Meetings Facilitation

Project Steering Committee meetings will be facilitated by CDM Smith staff. Meetings will be in person at the Old Colony Planning Council located at 70 School St, Brockton, MA 02301.

ATTACHMENT 3
EXAMPLE COMMUNITY DATA REQUEST

Request for Information

Community Name: Pembroke

Steering Committee Representative: Dan Sullivan

Due Date: 2/5/2023

Form filled out by: ______________________________

Instructions:

To develop the annotated bibliography that will support the Regional Water Plan, we ask the steering committee members to help coordinate data transmittal to CDM Smith. **For reports listed in Table 1, we ask that you coordinate with the necessary individuals to be able to transmit these to CDM Smith, preferably by 2/5/2023. Please upload these documents to your communities SharePoint link folder, which will be sent by Amara Regehr following this workshop. Please mark any documents that you only want to be shared with CDM Smith as "CONDIFENTIAL_" at the beginning of the file name.**

CDM Smith has already accessed publicly available data sources, which are included in Table 2. We do not need these reports to be transmitted but have included them here for completeness. For some of these publicly available data and reports, there are questions for your community. We ask that you provide a response in the column marked "community response". Please upload a version of this document with the answers the SharePoint link folder or send via email.

Table 1: Reports and data to be transmitted to CDM Smith

Report Type	**Date Transmitted**
From Pembroke Water Department please transmit any of these reports that may exist. It is likely that many do not exist but please transmit any that you have or are related <u>Populations and Demand</u> ☐ Current and historical population ☐ Historical public water supply use data ☐ Historical agricultural water use ☐ Water demand projections, preferably by sector ☐ Details of any ongoing water conservation requirements <u>Facilities</u> ☐ Service Areas Boundaries PDF map ☐ Growth Potential from the planning board ☐ Current capacities (withdrawal, treatment, conveyance) <u>Existing Plans and Previous Studies</u> ☐ Watershed plans ☐ Comprehensive water management plans ☐ Integrated water resource plans ☐ **Water master plans - HIGH PRIORITY** ☐ Drought contingency plans	

Request for Information

Report Type	Date Transmitted
☐ Water Quality/Source water protection plans ☐ Emergency impact assessments ☐ PFAS Data ☐ Climate action and Risk/Resiliency Plans ☐ Annual Water/Statistical Reports ☐ Emergency Response Plans ☐ Infrastructure Assessments and Feasibility Studies	
Pembroke Comprehensive Master Plan	
Any other relevant reports	

Table 2: Publicly Available Reports (CDM Smith does not these reports to be transmitted)

Report Type	CDM Smith Access	CDM Smith's Question	Community Response
Source Water Assessment and Protection (SWAP) Report	Publicly Available	Have there been any updates to municipal water sources since 2003? In 2003, 5 municipal wells were identified as the source water for Pembroke.	
Pembroke Water Department Water Management Act Permit #9P-4-21-231.01 (January 3, 2018)	Publicly Available	N/A	N/A
Silver Lake Water Quality Monitoring Program	Publicly Available	N/A	N/A
Pembroke Open Space and Recreation Plan	Publicly Available	N/A	N/A
Pembroke Water Quality Report	Publicly Available	N/A	N/A
Old Colony Planning Council Hazard Mitigation Plan (HMP)	Publicly Available	N/A	N/A
Pembroke Municipal Vulnerability Preparedness and Hazard Mitigation Plan	Publicly Available	N/A	N/A

ATTACHMENT 4
SIGN-IN SHEET

1/29/2024

Sign-In

Name	Organization & Title	E-mail
JOHN HAINES	EAST BRIDGEWATER	jhaines@eastbridgewaterma.gov
Dan Sullivan	Pembroke Water Dept.	Dsullivan@TownofPembrokemass.org
MARGHERITA PRYOR	U.S. EPA REGION 1	pryor.margherita@epa.gov
Pine du Bois	Jones River WA, Exec Dir	pine@jonesriver.org
Philip A. McNulty	Stoughton Water & Sewer	pmcnulty@stoughton-ma.gov
Jason Duff	MA Dept. Conservation and Recreation	jason.duff@mass.gov
GREG SWAN	EASTON DPW	GSWAN@EASTON.MA.US
JONATHAN BEDER	TOWN OF AVON	JBEDER@AVON-MA.GOV
Bob Rulli	Town of Bridgewater	rrulli@bridgewaterma.org
Art Egerton	CPCWDC	artegerton@gmail.com
Kimberly Groff	CPCWDC, Representative	kimberlygroffma@gmail.com
Wayne Parks	West Bridgewater Water, Superint	wparks@wbridgewater.com
Brian Vasa	Town of Plympton	plymptonconcom@gmail.com
Noreen O'Toole	Whitman	noreen@platinumpartnersllc.com

Name	Organization & Title	E-mail
Peter Gordon	Plymouth DPW Water Division	Pgordon@plymouth-ma.gov
Greg Tansey	BRIDGEWATER TOWN GOVT.	gtansey@bridgewaterma.ORG
KEITH SONIA	REGINA VILLA ASSOCIATES	KSonia@reginavilla.com
Kyle Olsen	Regina Villa Associates	Kolsen@reginavilla.com
Tarun Gill	CDM Smith	gillt@cdmsmith.com
Kara Rozycki	CDM Smith	rozyckikm@cdmsmith.com
Amara	CDM Smith	
Kirk	CDM Smith	
Patrick Hill	City of Brockton	phill@cobma.us

Zoom:

Martin Pillsbury — MAPC

Peter Forman — Chamber of Commerce

Karla Kahale — Sen. Brady's Office

Appendix F
Steering Committee Meeting 2
02-28-2024

OLD COLONY
PLANNING COUNCIL

Rebecca Coletta, President | Mary Waldron, Executive Director

(508) 583-1833 | 70 School Street, Brockton, MA 02301 | www.oldcolonyplanning.org

Regional Water Plan
Steering Committee Meeting
MINUTES OF THE MEETING
Wednesday, February 28, 2024, 9:00am

Location: Old Colony Planning Council, 70 School St, Brockton, MA 02301

Attendees:

Steering Committee	
Organization	**Name**
Town of Abington	Liz Shea
Town of Bridgewater	Bob Rulli
Bridgewater Engineering	Greg Tansey
CPCWDC	Art Egerton
CPCWDC	Kimberly Groff (via Zoom)
East Bridgewater	John Haines
Easton Department of Public Works	Greg Swan
Town of Kingston	Val Massard
MA Department of Conservation and Recreation	Jason Duff
MassDEP	Duane LeVangie
MA State Senate	Senator Michael Brady (via Zoom)
MA State Senate	Al DeGirolamo (Via Zoom)
Pembroke Water Department	Dan Sullivan
OCPC	Joanne Zygmunt
Town of Plymouth	Kendra Martin
Town of Plympton	Brian Vasa
Stoughton Water & Sewer Department	Philip A. McNulty
Town of Whitman	Noreen O'Toole
U.S. EPA Region 1	Margherita Pryor
Watershed Associations	Pine duBois
Watershed Associations	Kimmy Powell

Observers	
Organization	**Name**
MAPC	Martin Pillsbury (via Zoom)
OCPC	Bill Napolitano
OCPC	Don Sullivan

Consultants	
Organization	**Name**
CDM Smith	Dan Rodrigo (via Zoom)
CDM Smith	Kirk Westphal
CDM Smith	Tarun Gill
CDM Smith	Amara Regehr
CDM Smith	Grace Inman (via Zoom)
Regina Villa Associates	Keith Sonia
Regina Villa Associates	Kyle Olsen

Minutes:

1. Call to Order

2. Introductions

3. OCPC Comments and Overview on Public Outreach

    a. There is a public outreach meeting scheduled for March 19th, 5-8 pm at Bridgewater State University.

    b. There will be interviews of each municipality separately, conducted by Regina Villa Associates and OCPC.

4. Public Comments - There were no comments.

5. Guiding Principles

    a. Overview of 12 meetings anticipated throughout the project duration.

        i. Meeting 1: Introductions/Process
        Meeting 2: Principles, Common Issues (current)
        Workshop 1: Objectives
        Workshop 2: Performance Metrics
        Workshop 3: Water Supply Alternatives: Local, Regional, External
        Workshop 4: Evaluation
        Workshop 5: Comparison of Alternatives
        Workshop 6: Strategic Portfolios
        Workshop 7: Adaptative Strategy
        Meeting 3: Draft Plan

Meeting 4: Implementation Strategy and Priorities
Meeting 5: Final Plan

b. Review of Engagement Guidelines:

   i. All participants agreed to abide by the following, presented on slides:

      1. We agree that there will be one voice for each organization.

      2. We will actively listen to others and take turns while speaking.

      3. We will represent our organizations, as well as those with similar challenges, and the region

      4. Regulators will join us to provide feasibility insights, lessons from other regions, guardrails and their own education about the needs in the region

      5. We will seek to arrive at a point where we can advocate for the plan.

      6. As a group, we will make recommendations, not necessarily decisions.

      7. We will be patient with the pace of this project.

      8. For resolving conflict: We will recommend what we agree on, based on regional progress toward objectives. We will forge "pathways" for next steps on issues not resolvable within this timeframe. We will document opinions on all sides of unresolved issues in the plan.

   ii. While recognizing that this process will involve debate and disagreements as part of consensus building, in the interest of making forward and constructive progress, collaborating as colleagues, and focusing on the driving issues, CDM Smith and OCPC have added the following engagement protocol for future meetings:

      1. Debate and disagreement are part of this process, but they must be constructive, forward looking, and respectful.

   iii. Sustainability: Balance social, economic, and environmental issues.
   iv. Understand the limits of our resources.
   v. Consider equity between and among communities.
   vi. Plan for uncertainty.
   vii. Consider innovative and alternative solutions.
   viii. Support and promote growth and economic development of the region.
   ix. Identify fundable and permittable alternatives for OCPC to champion.
   x. Align with existing regulations while influencing application and interpretation of the Water Management Act

c. Comments

   i. How can we regenerate resources we know we are going to use unsustainably?

1. Part of this process will include completing a supply and demand gap analysis to better understand the limits of the water resources.

ii. MTBA communities are worried about balancing economic growth with demand. There are also concerns about economic growth impacts on environmental health.

iii. How can we incorporate agricultural/industrial users in this process?

1. Cranberry growers should be included in the steering committee.

6. Second Example of the Planning Process: Regional and Local Benefits

a. Dan describes the planning process of a Regional Water Supply plan in Austin, TX. Describes Austin's Guiding Principles and Public Outreach goals and the evaluation framework used to develop their plan.

b. Austin implemented incentive programs to help houses install decentralized infiltration and treatment systems.

c. The core stakeholder task force is still functioning and advising the plan. However, Austin Water oversees the actual implementation. Their plan is adaptive and active.

d. One of the goals of these meetings is to make a standing water resource committee to continue to provide oversight and guidance.

7. Themes from Meeting 1

a. Focusing on long-term horizons
b. Regulations (especially chapter 40b)
c. Affordability
d. MTBA Requirements
e. Water Quality
f. Funding realities
g. Recreation use
h. Growing Demand
i. Climate Change
j. Maintaining and upgrading infrastructure
k. Link to economic development
l. Sustainable water supply
m. Political support
n. Environmental impacts
o. Comments:
   - Include funding realities, recreational issues, and update environmental issues to be more specific, something like Ecosystem Health.
   - Many of these issues are all tied to meeting demand.

8. Common Themes Discussion

a. Mapping of Common Themes

i. Stakeholders Map
ii. Water Supply Map

iii. Purchased Water Map
iv. Themes Maps
1. PFAS
2. Water Quality
3. Environmental Issues
4. Climate
5. Regulations
6. MTBA Growth Requirements
7. Coasts and Infrastructure
8. Supply and Demands

b. Comments
i. Agreement on the common themes as being regional issues relevant to the Regional Water Plan.
ii. There is universal concern about stricter PFAS regulations.

9. Update on Data Gathering

a. CDM Smith is awaiting data from some towns, including Avon, Bridgewater, Duxbury, Hanover, Hanson, Kingston, and Whitman as well as from the Jones River Watershed Association.

10. Discussion of Uncertainties

a. We want to create a list of elements of uncertainty that the plan could attempt to address.

i. Climate change
ii. Rate of economic growth
iii. Costs
iv. Unplanned regulatory changes
v. PFAS and emerging contaminants
vi. Political uncertainty- who manages the water
vii. Demographic changes
viii. Invasive Species
ix. Drought
x. Public health issues
xi. Decisions by neighboring non-OCPC communities
xii. Population
xiii. Changes in how homes are built

11. Closing Remarks
a. At the next meeting, the steering committee will work to develop a list of meaningful objectives, with Dan Rodrigo attending in person to support. The next meeting will be on Monday, March 18th from 9 am to 12 pm. The public meeting will be Tuesday, March 29th from 5 pm to 8 pm at Bridgewater State University in the Maxwell Library Heritage Room.
b. Survey handed out.

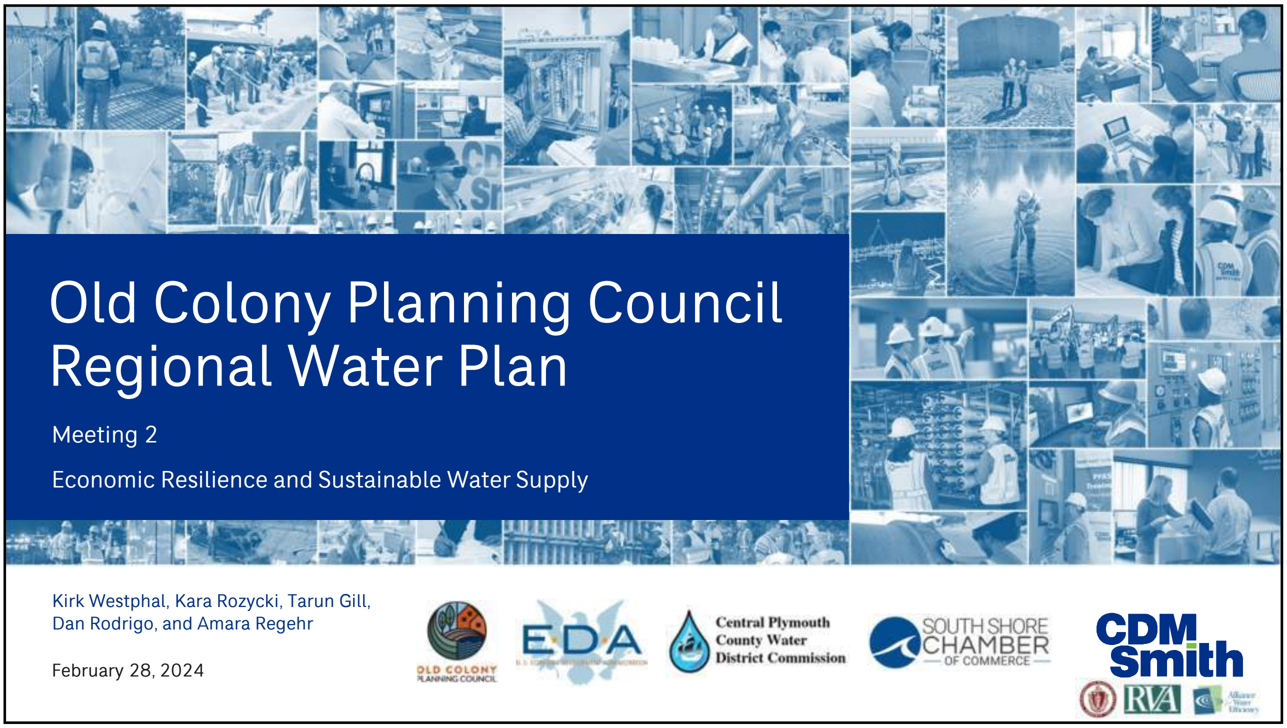
Action Items:

Assigned to	Action Item
Amara	Provide maps, survey to online participants and summary meeting notes following the call
Dan, Kirk, Amara	Finalize the steering committee's guiding principles
Amara	Create a handout with the vision statement, guiding principles, and definitions for guiding principles, objectives, and metrics for next meeting
Steering Committee members	Provide requested data, if not done
Joanne/ Kara	Ongoing: Invite additional stakeholders to future meetings: DMF and any others
RVA	Coordinate with steering committee members to set up interviews

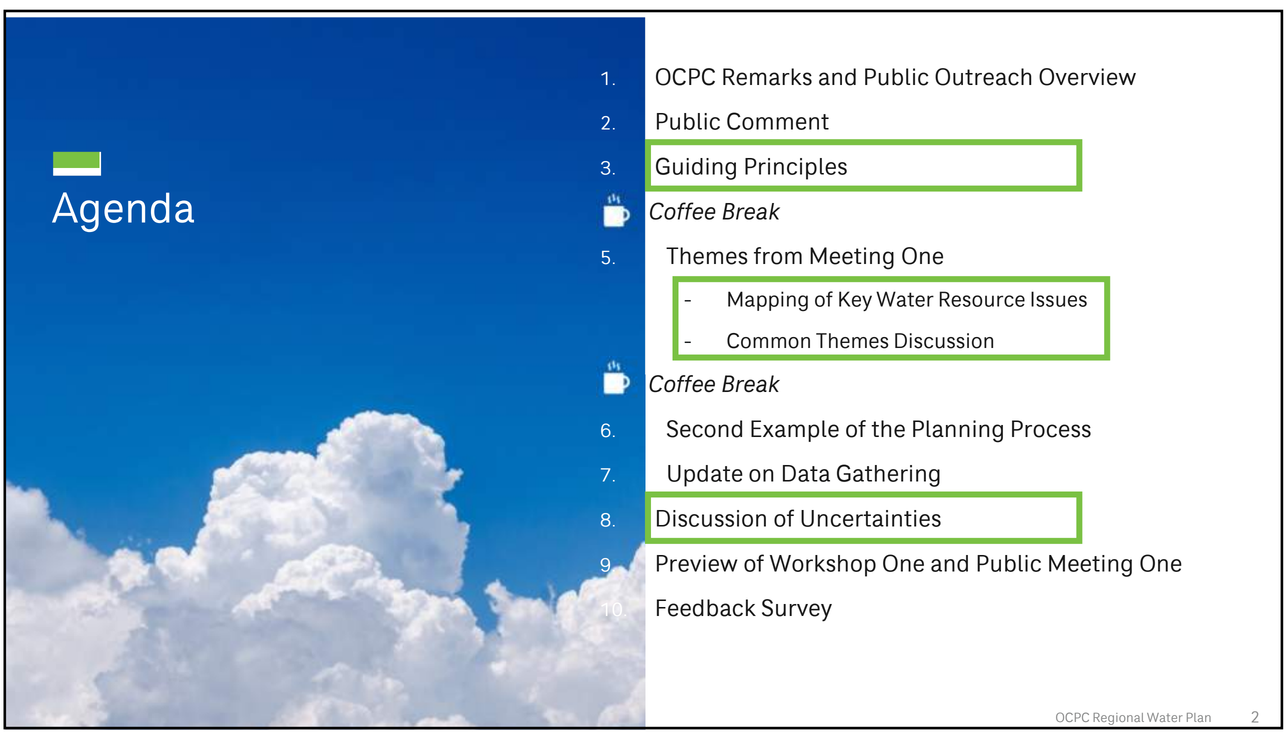
Attachments:

1. Meeting Presentation Slides
2. Maps
3. Meeting Sign-In Sheet
4. Feedback Survey

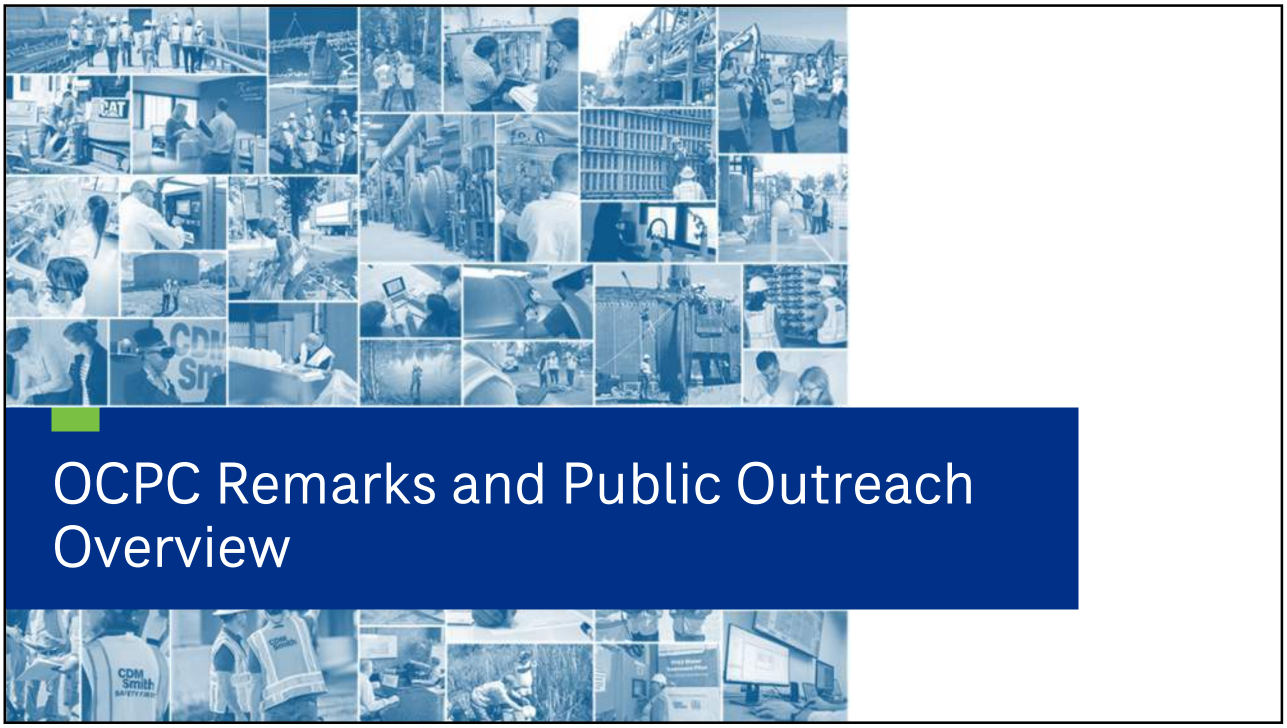
Prepared by CDM Smith.


Old Colony Planning Council
Regional Water Plan
Meeting 2
Economic Resilience and Sustainable Water Supply
Kirk Westphal, Kara Rozycki, Tarun Gill, Dan Rodrigo, and Amara Regehr
February 28, 2024
OLD COLONY PLANNING COUNCIL
EDA
Central Plymouth County Water District Commission
SOUTH SHORE CHAMBER OF COMMERCE
CDM Smith
RWA

1


Agenda
1. OCPC Remarks and Public Outreach Overview
2. Public Comment
3. Guiding Principles
Coffee Break
5. Themes from Meeting One
- Mapping of Key Water Resource Issues
- Common Themes Discussion
Coffee Break
6. Second Example of the Planning Process
7. Update on Data Gathering
8. Discussion of Uncertainties
9. Preview of Workshop One and Public Meeting One
10. Feedback Survey
OCPC Regional Water Plan 2

2



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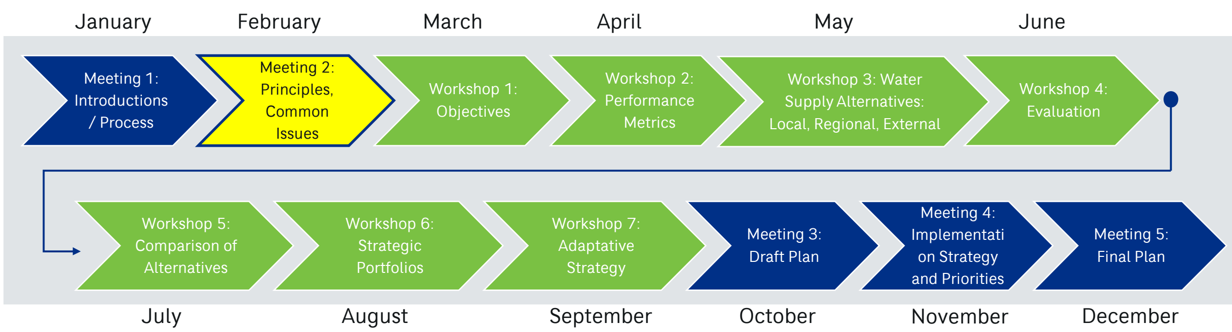
Overview of Regional Water Plan Process

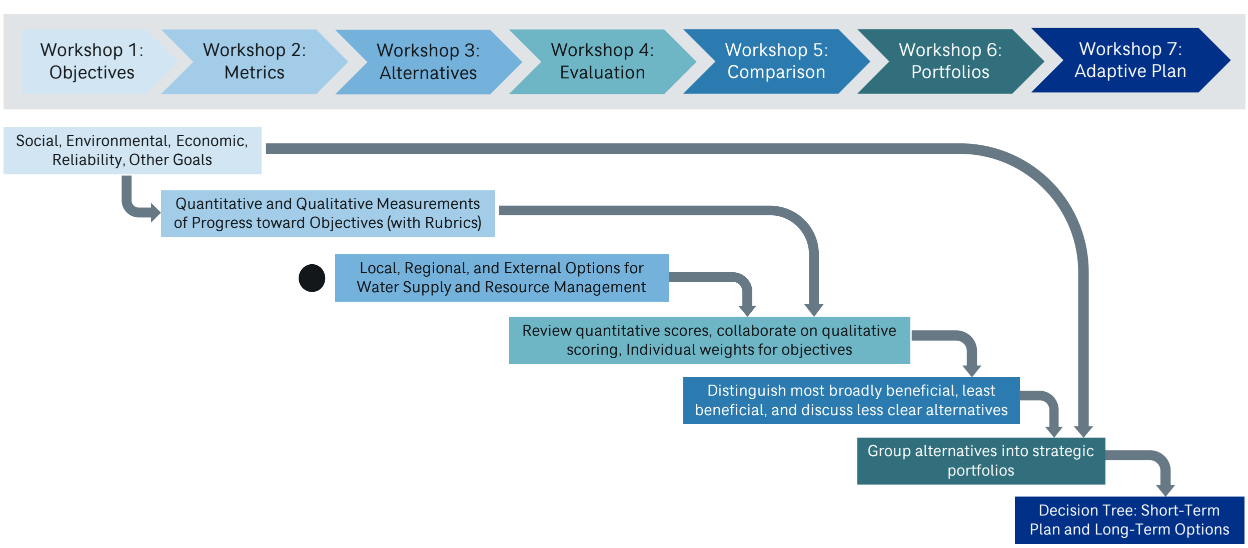


OCPC Regional Water Plan 5

5

RAJ27

Workshop Process

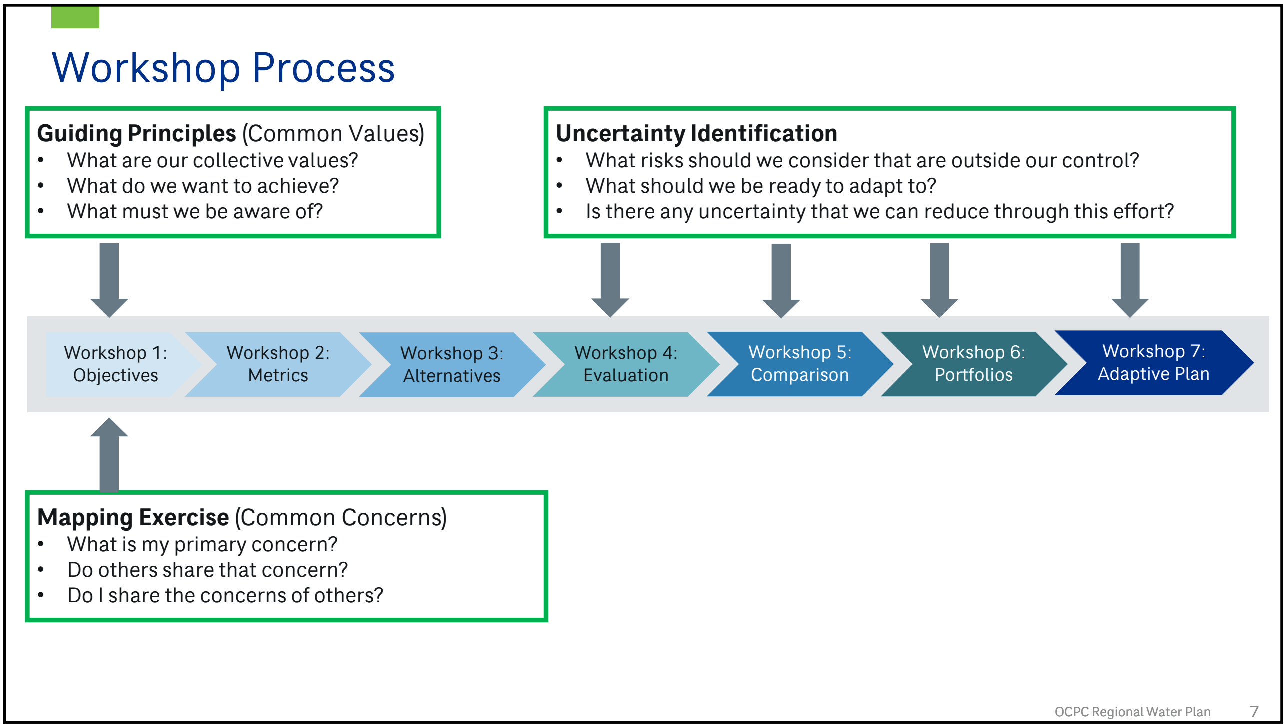


OCPC Regional Water Plan 6

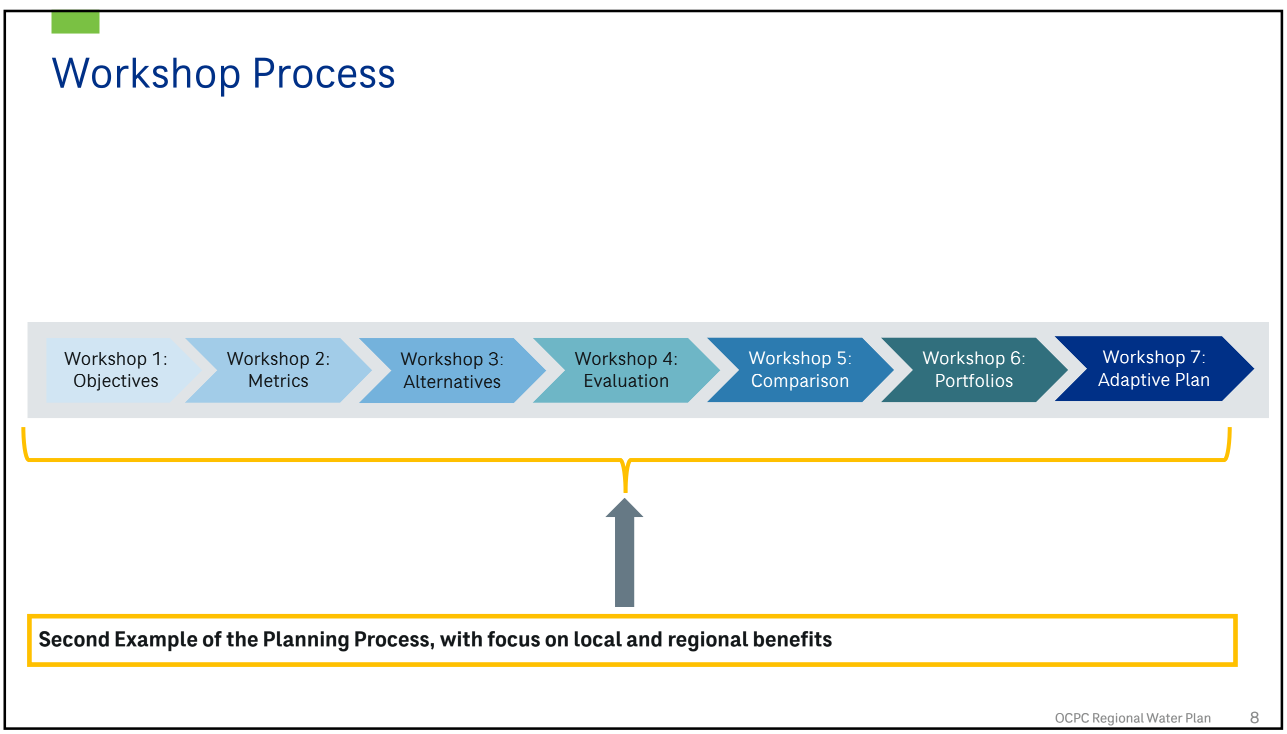
6

Slide 6

RAJ27 Amara to add in animation
Regehr, Amara J., 2/19/2024


Workshop Process
Guiding Principles (Common Values)
• What are our collective values?
• What do we want to achieve?
• What must we be aware of?
Uncertainty Identification
• What risks should we consider that are outside our control?
• What should we be ready to adapt to?
• Is there any uncertainty that we can reduce through this effort?
Workshop 1: Objectives
Workshop 2: Metrics
Workshop 3: Alternatives
Workshop 4: Evaluation
Workshop 5: Comparison
Workshop 6: Portfolios
Workshop 7: Adaptive Plan
Mapping Exercise (Common Concerns)
• What is my primary concern?
• Do others share that concern?
• Do I share the concerns of others?
OCPC Regional Water Plan 7

7


Workshop Process
Workshop 1: Objectives
Workshop 2: Metrics
Workshop 3: Alternatives
Workshop 4: Evaluation
Workshop 5: Comparison
Workshop 6: Portfolios
Workshop 7: Adaptive Plan
Second Example of the Planning Process, with focus on local and regional benefits
OCPC Regional Water Plan 8

8

Introductions

- Name
- Community or organization you are representing
- Position/Title

9

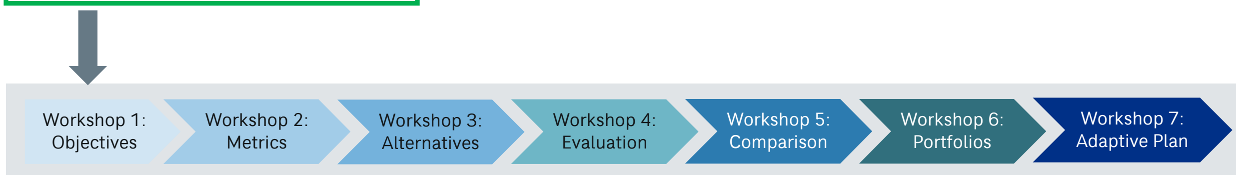
9

Guiding Principles

10

Guiding Principles within the Workshop Process

Guiding Principles (Common Values)
- What are our collective values?
- What do we want to achieve?
- What must we be aware of?



Engagement Protocols

Engagement Protocols	We agree that there will be one voice for each organization.
	We will actively listen to others and take turns while speaking.
	We will represent our organizations, as well as those with similar challenges, and the region
	Regulators will join us to provide feasibility insights, lessons from other regions, guardrails and their own education about the needs in the region
	We will seek to arrive at a point where we can advocate for the plan.
	As a group, we will make recommendations, not necessarily decisions.
	We will be patient with the pace of this project.

Engagement Protocols Continued

Engagement Protocols

For resolving conflict:

We will recommend what we agree on, based on regional progress toward objectives.

We will forge “pathways” for next steps on issues not resolvable within this timeframe.

We will document opinions on all sides of unresolved issues in the plan.

13

RAJ44 RAJ45

Example Guiding Principles

- **Sustainability lens-** Balance social, economic, and environmental issues
  - **Gap in conservation. Is the education process where it should be? At what level could we consider education?**
  - **Environmental issues gap analysis- we would need to clearly define what we are assessing.**
- **Understand the limits of the resource we have**
  - **Incorporation of agricultural/ industrial users in this process (cranberry growers- Brian Wick)**
  - **How can we regenerate the resource for all users?**
  - **Do we understand the limits of groundwater use in this region?**
- Consider equity between and within communities
- Plan for uncertainty
- Consider innovative and alternative solutions- **what are we talking about? Can we consider reuse?**
- Support and promote growth and economic development of the region
  - **MBTA communities- we have to balance infrastructure growth**
  - **Herring harvests- restore environmental health**
- Identify fundable and permittable alternatives for OCPC to champion
- Align with existing regulations while influencing application and interpretation of the Water Management Act

14

Slide 14

RAJ44 Incorporate cranberrie / agricultural use in the conversation
Regehr, Amara J., 2/28/2024

RAJ46 Brian WIck (executive director)
Regehr, Amara J., 2/28/2024

RAJ45 Regehr, Amara J., 2/28/2024

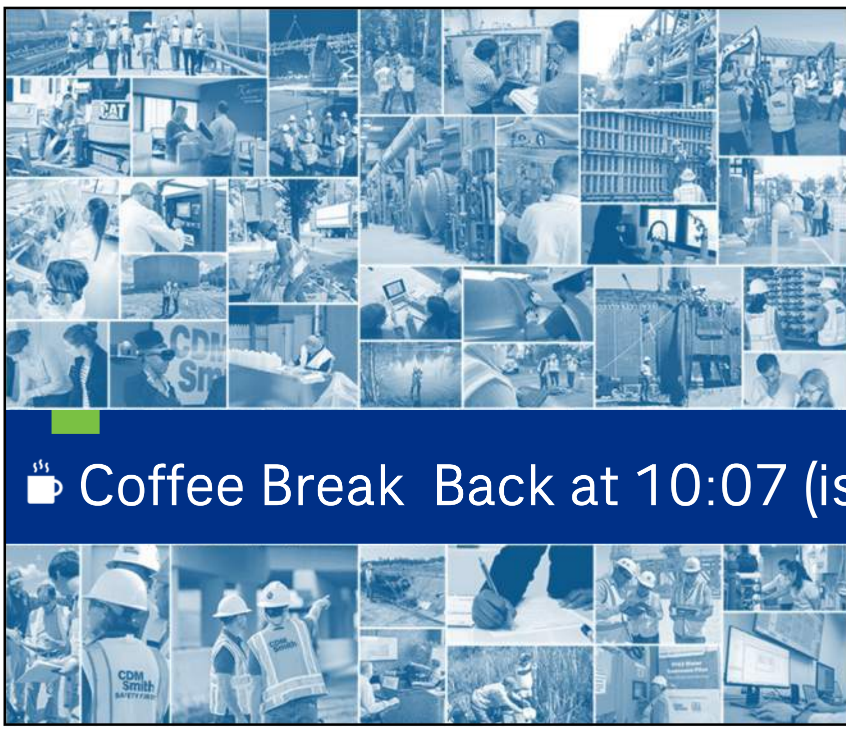
Our Guiding Principles

RAJ47

15

OCPC Regional Water Plan 15

15



☕ Coffee Break Back at 10:07 (ish)

16

Slide 15

RAJ47 add in definition of guidng principle

Regehr, Amara J., 2/28/2024

Themes from Meeting One

17

Common Themes within the Workshop Process

Workshop 1: Objectives → Workshop 2: Metrics → Workshop 3: Alternatives → Workshop 4: Evaluation → Workshop 5: Comparison → Workshop 6: Portfolios → Workshop 7: Adaptive Plan

Mapping Exercise (Common Concerns)
- What is my primary concern?
- Do others share that concern?
- Do I share the concerns of others?

OCPC Regional Water Plan 18

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Themes from Meeting 1: Discussion

What do you see are the most important issues for us to address?

- Focus on long term time horizons
- Regulations- chapter 40b
- Affordability
- MBTA Requirements
- Abington- out of water, expansion of wells, PFAS, consumer water quality concerns
- unding realities
- Water quality
- Growing Demand
- Climate change
- Maintaining or upgrading infrastructure
- Kingston- separate water commission. Out of water, no money for new well and no new well site
- ecreational issues
- Environmental Impacts- Update to include ecosystem health – take a look at categories
- Link to economic development
- Sustainable water supply
- Political support

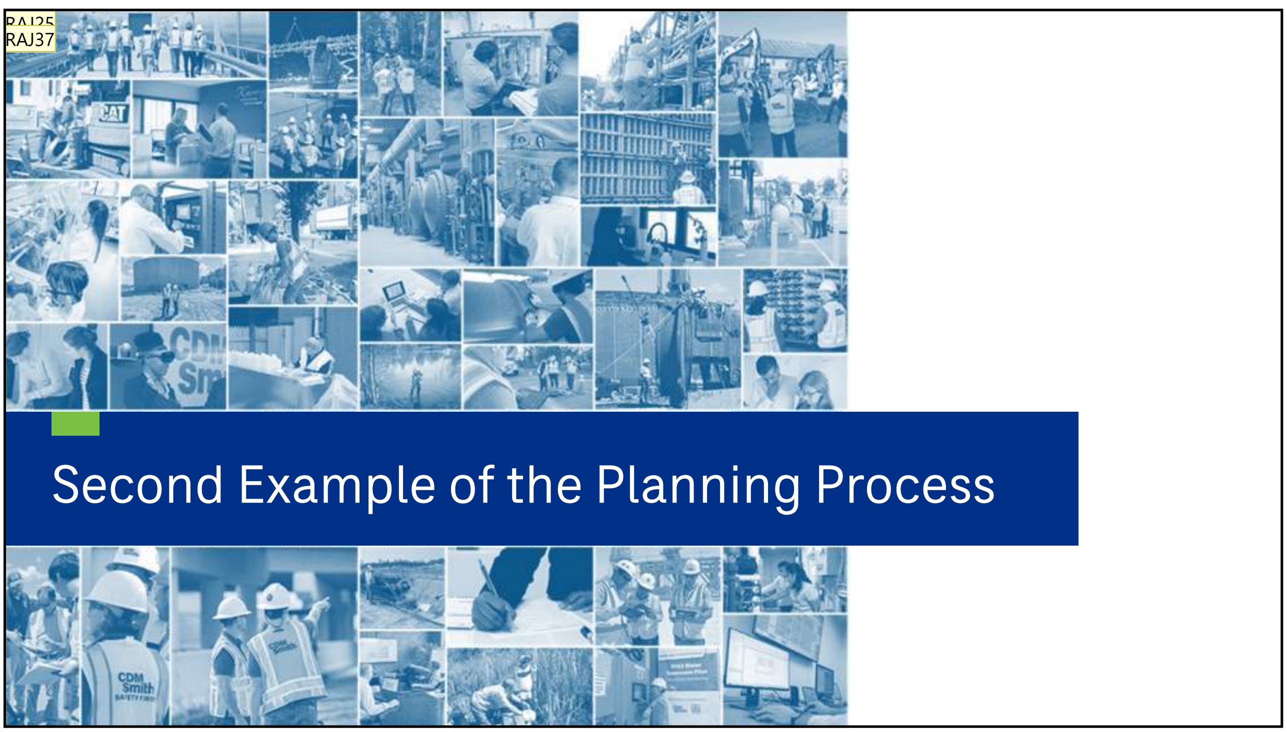
19

Mapping of Concerns

- Build consensus around top issues related to water in the region
- Lay the foundation for developing our objectives in the next meeting
- Questions to consider:
  - What is my primary concern?
  - Do others share that concern?
  - Do I share the concerns of others?

20

21



22

Slide 22

RAJ25 [@Westphal, Kirk S.] to add in second example that Dan creates
Regehr, Amara J., 2/19/2024

RAJ37 kirk to make a handout for meeting 2 based off of this example
Regehr, Amara J., 2/19/2024

Austin WATER

WATER FORWARD

INTEGRATED WATER RESOURCE PLAN

OCPC Regional Water Plan 23

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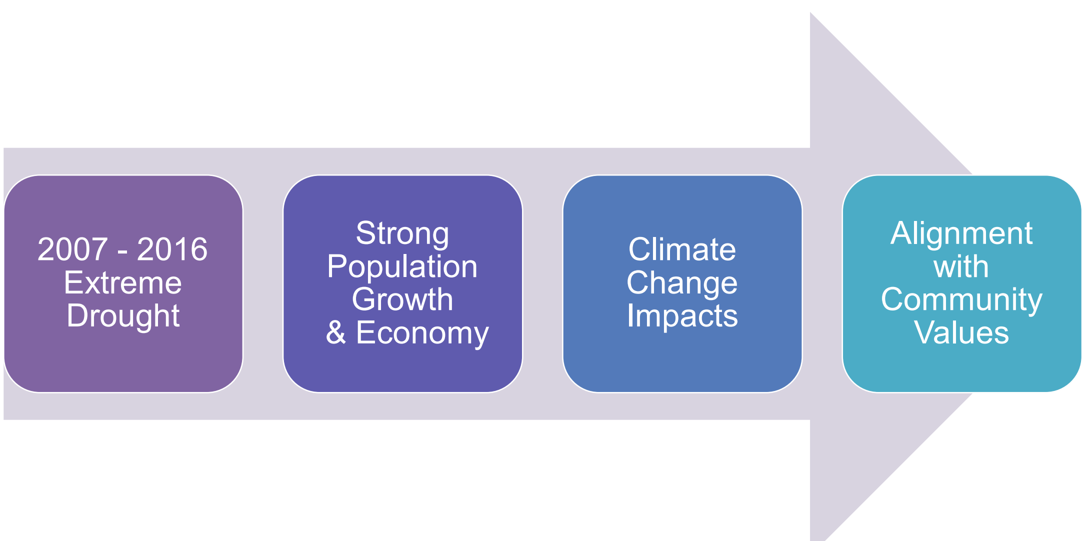
Drivers for 100 - Year Plan



OCPC Regional Water Plan 24

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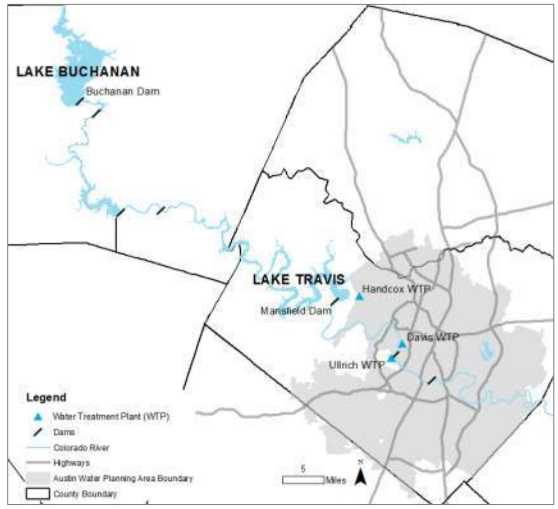
Austin's Water Supply

- Colorado River and Highland Lakes
- Combination of state-granted water rights & long-term firm contract with Lower Colorado River Authority (LCRA)
- 12 other communities rely on LCRA for water supply besides Austin



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Historic 2011-2016 Drought

Lake Travis, July 2010 and July 2015

OCPC Regional Water Plan 26

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Guiding Principles for Plan Development

Protect	▪ Local Public Health ▪ Local/Regional Environment ▪ Colorado River for Entire Region
Focus On	▪ Water Reliability ▪ Expanded Water Efficiency ▪ New Local Water Supplies ▪ Resiliency to Climate Change
Align With	▪ Community Values ▪ Imagine Austin ▪ Regional Coordination

OCPC Regional Water Plan 27

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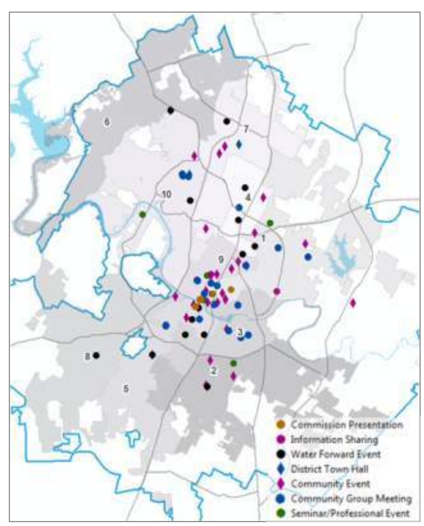
Public Outreach Goals

- Identify community values to reflect in plan
- Seek input from local and regional stakeholders on plan development
- Inform and educate the community throughout the process

Map of over 90 public outreach events attended by Water Forward project team



OCPC Regional Water Plan 28

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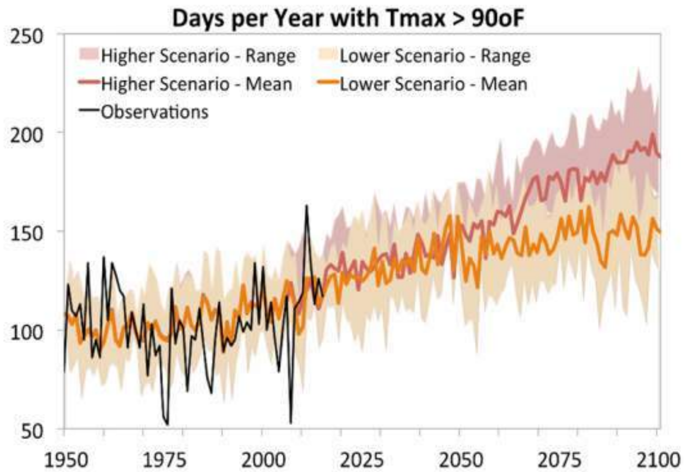
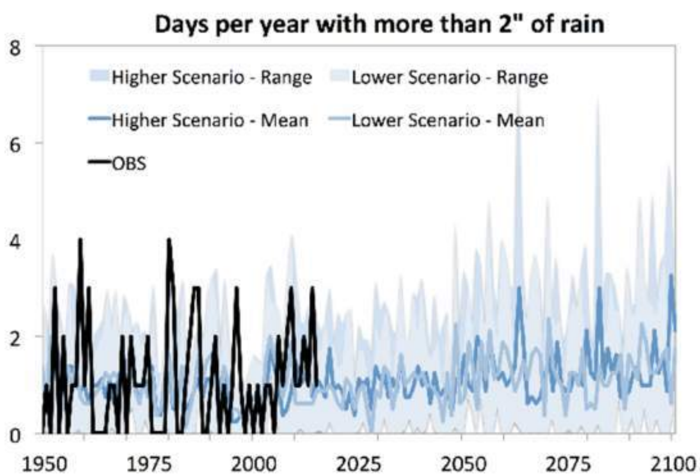
Incorporation of Climate Change- Findings for Austin Area

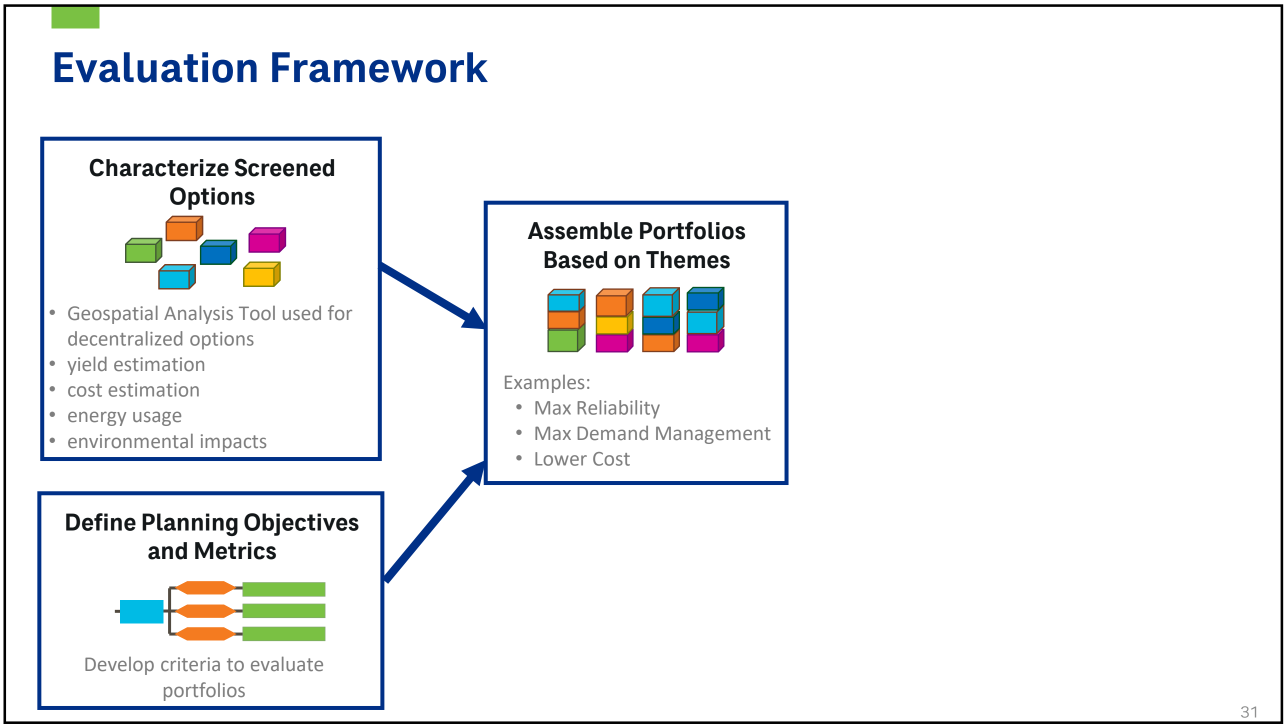


1. Substantially greater temperatures—leading to increased water demands, and increased evaporation in surface reservoirs

Incorporation of Climate Change- Findings for Austin Area



2. More variability in rainfall—leading to longer drought periods, but also increased storm intensities and opportunities for stormwater capture


Evaluation Framework
Characterize Screened Options
Geospatial Analysis Tool used for decentralized options
yield estimation
cost estimation
energy usage
environmental impacts
Define Planning Objectives and Metrics
Develop criteria to evaluate portfolios
Assemble Portfolios Based on Themes
Examples:
Max Reliability
Max Demand Management
Lower Cost
31

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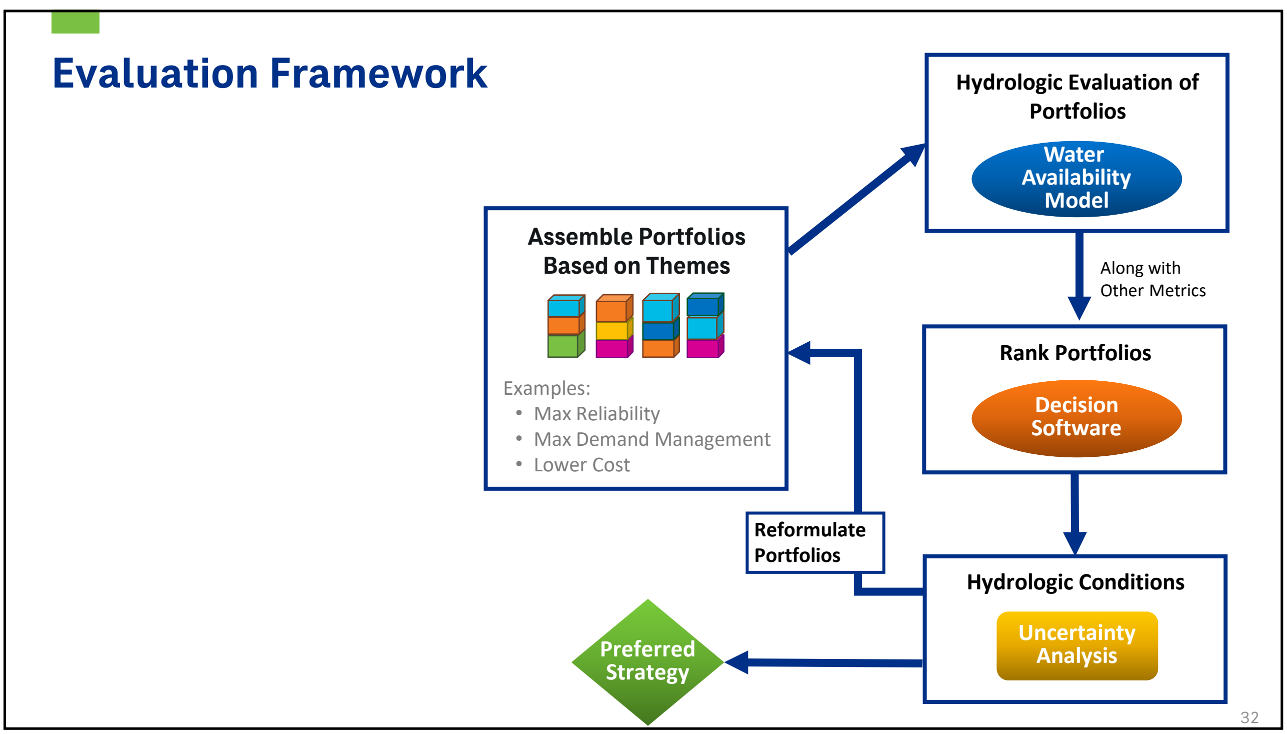
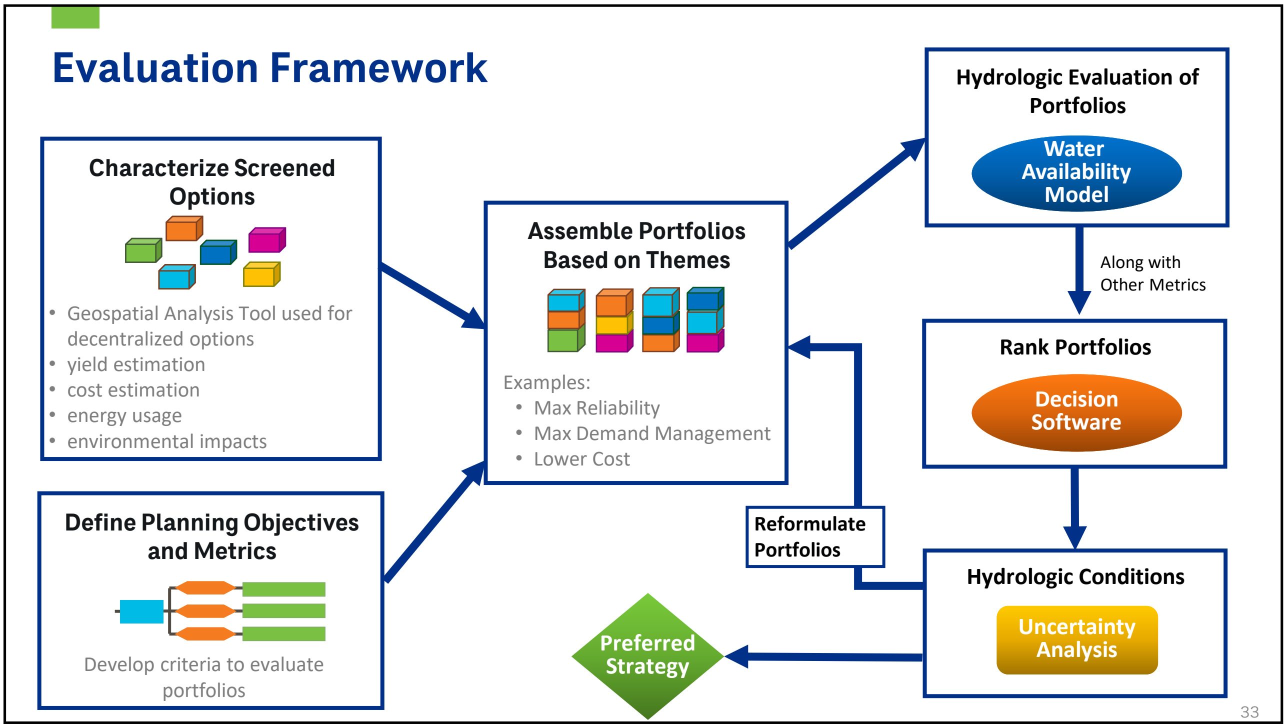

Evaluation Framework
Assemble Portfolios Based on Themes
Examples:
Max Reliability
Max Demand Management
Lower Cost
Hydrologic Evaluation of Portfolios
Water Availability Model
Along with Other Metrics
Rank Portfolios
Decision Software
Hydrologic Conditions
Uncertainty Analysis
Reformulate Portfolios
Preferred Strategy
32

32



33

Objectives and Criteria

Objective	Objective Weight	Criteria	Criteria Weight
Water Supply Benefits	25%	Maximize Resiliency	15%
		Increase Diversity of Sources	10%
Economic Benefits	25%	Provide Cost-Effective Services	15%
		Support Local/Regional Economy	10%
Environmental Benefits	20%	Reduce Impacts to Ecosystems	12%
		Meet GHG Emission Reductions	8%
Social Benefits	20%	Maximize Social Justice	10%
		Preserve Colorado River for All	10%
Implementation Ease	10%	Reflect Permitting/Legal Issues	10%

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Portfolios (Combinations of Options)

Portfolio Theme	Description
Maximize Cost-Effectiveness	Options with the lowest unit costs ($/acre-foot/year) were generally selected.
Maximize Local Control	Options which are locally sourced or which Austin Water would have control over the projects and the water supplies in terms of cost, yield, development, and operations were generally selected.
Maximize Implementation	Options that have a higher degree of potential implementation success were generally selected.
Maximize Reliability	Options that provide higher supply reliability and resiliency in terms of climate and hydrology were generally selected.
Maximize Conservation	Options that conserve water and maximize the reuse of treated wastewater and stormwater were generally selected.
Hybrid 1	Built from the initial Maximize Conservation portfolio with the intent of increasing water supply benefits, while not significantly impacting the environmental and social benefits. This was achieved by increasing storage and reuse options.
Hybrid 2	Built from the initial Maximize Reliability portfolio with the intent of increasing environmental and social benefits, while reducing cost and risk. This was achieved by increasing demand management options, scaling back on seawater desalination and eliminating direct potable reuse.

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Ranking of Portfolios

36

Plan Recommended Strategies

Demand Management

- Advanced Metering
- System Water Loss Control
- Water Use Benchmarking
- Water Budgets
- Landscape Transformations
- Irrigation Efficiency

Water Supply

- Expansion of Centralized Reclaimed Water
- New Aquifer Storage/Recovery
- New Off-Chanel Reservoir
- New Brackish Groundwater Desalination
- New Indirect Potable Reuse

Decentralized

New Lot and Neighborhood Scale Alternative Sources for Non-Potable Uses
(Graywater/Blackwater, Rainwater Harvesting, Stormwater Capture, WW Scalping)

OCPC Regional Water Plan 37

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Anticipated Benefits

Local

- Reduced mandatory restrictions during droughts
- Improved delivered water quality
- Increased sustainability
- Stabilization of water rate increases
- Matching right quality of water to correct demand

Regional

- Reduced reliance on Colorado River
- Job creation and improved regional economy
- Protection of regional ecosystem and recreational resources

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Update on Data Gathering

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Data Requests

Abington	Avon	Bridgewater	Brockton	Duxbury
East Bridgewater	Easton	Halifax	Hanover	Hanson
Kingston	Pembroke	Plymouth	Plympton	Stoughton
West Bridgewater	Whitman	Watershed Associations	Central Plymouth County Water District Commission	

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Data Requests

Abington	Avon	Bridgewater	Brockton	Duxbury
East Bridgewater	Easton	Halifax	Hanover	Hanson
Kingston	Pembroke	Plymouth	Plympton	Stoughton
West Bridgewater	Whitman	Watershed Associations	Central Plymouth County Water District Commission	

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RAJ26

Discussion of Uncertainties

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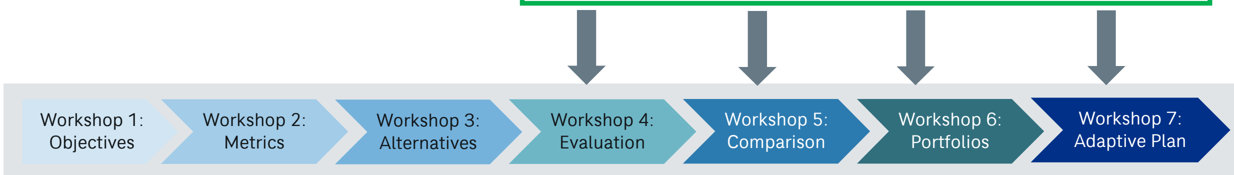
Slide 42

RAJ26 [@Westphal, Kirk S.] any thoughts on what visuals would be helpful to guide discussion?
Regehr, Amara J., 2/19/2024

Uncertainties within the Workshop Process

Uncertainty Identification
- What risks should we consider that are outside our control?
- What should we be ready to adapt to?
- Is there any uncertainty that we can reduce through this effort?



43

RAJ41

Discussion of Uncertainties

- What are factors that could affect the outcome of the plan?
- What are factors that could affect the planning process itself?

44

Slide 44

RAJ41 amara to talk to kirk about adding in a slide introducing adaptive management or talking to it when introducing this topic
Regehr, Amara J., 2/20/2024

Preview of Workshop One and Public Meeting One

45

Workshop Process

Workshop 1: Objectives → Workshop 2: Metrics → Workshop 3: Alternatives → Workshop 4: Evaluation → Workshop 5: Comparison → Workshop 6: Portfolios → Workshop 7: Adaptive Plan

What goals should we be considering?
Social, Environmental, Economic, Reliability, Other Goals

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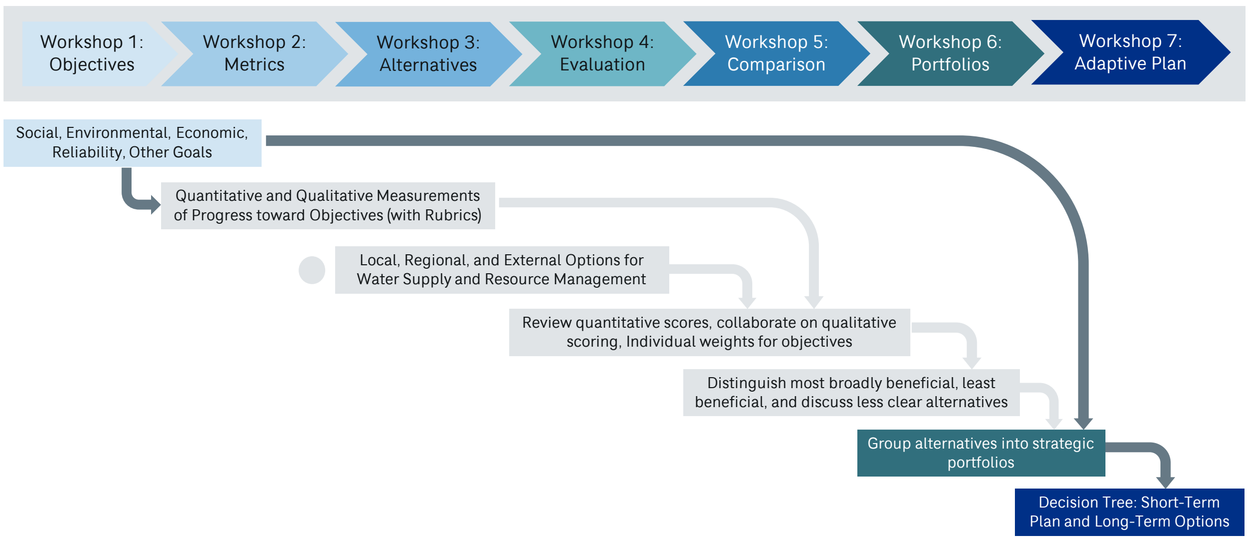
Workshop Process



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Upcoming Schedule

WHEN	DETAILS
Monday, March 18th 9:00 am – 12:00 pm	Workshop 1: Objectives
Tuesday, April 23rd 9:00 am – 12:00 pm	Workshop 2: Metrics
Monday, May 20th 9:00 am – 12:00 pm	Workshop 3
Tuesday, June 25th 9:00 am – 12:00 pm	Workshop 4
Wednesday July 31st 9:00 am – 12:00 pm	Workshop 5
Tuesday, August 27th 9:00 am – 12:00 pm	Workshop 6
Tuesday, September 24th 9:00 am – 12:00 pm	Workshop 7
Tuesday, October 29th 9:00 am – 12:00 pm	Meeting 3
Monday, November 18th 8:00 am – 12:00 pm	Meeting 4
Tuesday, December 10th 8:00 am – 12:00 pm	Meeting 5

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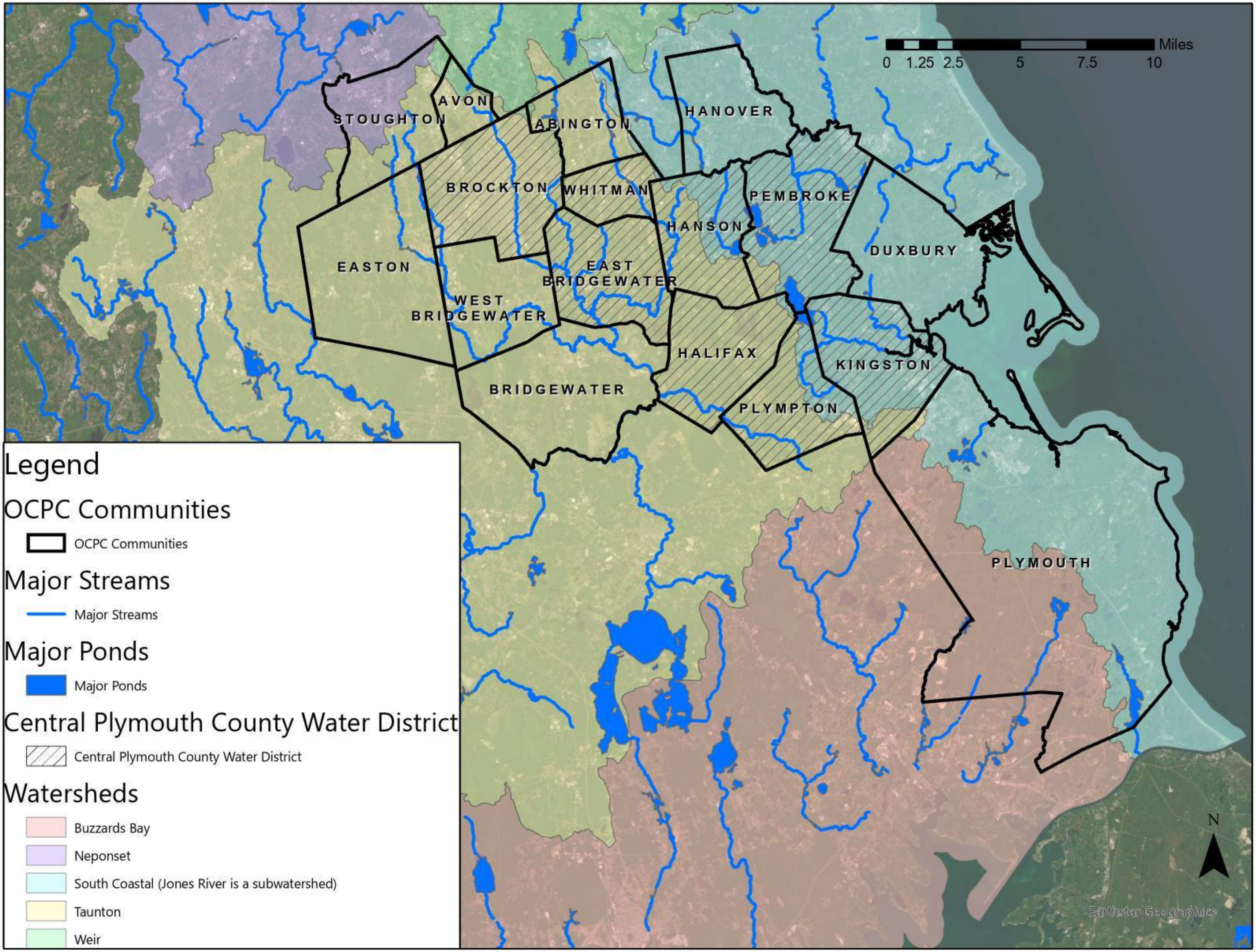

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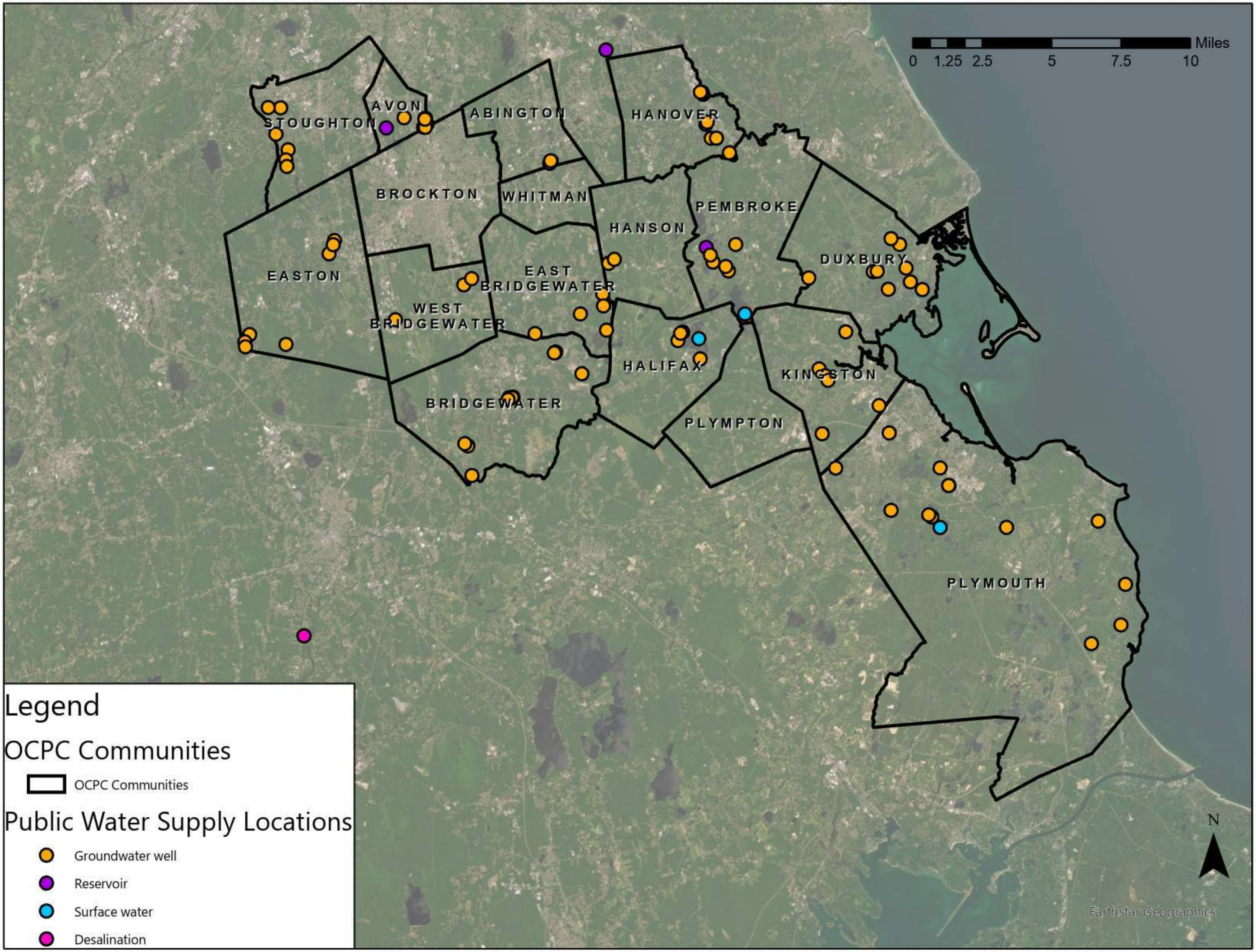
ABINGTON
HANOVER
BROCKTON
WHITMAN
PEMBROKE
HANSON
DUXBURY
EASTON
EAST BRIDGEWATER
WEST BRIDGEWATER
HALIFAX
KINGSTON
BRIDGEWATER
PLYMPTON
PLYMOUTH
Legend
OCPC Communities
OCPC Communities
Major Streams
Major Streams
Major Ponds
Major Ponds
Central Plymouth County Water District
Central Plymouth County Water District
Watersheds
Buzzards Bay
Neponset
South Coastal (Jones River is a subwatershed)
Taunton
Weir
N
Earthstar Geographics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HANSON
EASTON
EAST BRIDGEWATER
DUXBURY
WEST BRIDGEWATER
HALIFAX
KINGSTON
BRIDGEWATER
PLYMPTON
PLYMOUTH
Legend
OCPC Communities
OCPC Communities
Public Water Supply Locations
Groundwater well
Reservoir
Surface water
Desalination
N
Earthstar Geographics

MEETING FEEDBACK

Please complete this short survey at the end of today's meeting/workshop and drop it in the box by the exit. Your feedback will help us ensure this project meets the needs of the region, municipalities, and other stakeholders as we move forward. We want to make sure we use your valuable time efficiently and effectively and include everyone in the process. **Results will be used by OCPC and CDM Smith internally only.**

1. **Please tick one box per row.**	Strongly disagree	Disagree	Agree	Strongly agree
The meeting had a clear agenda.				
Facilitation of today's meeting was effective.				
I had plenty of opportunity to participate in the discussion today.				
Interactions were positive and respectful.				
I understand where we are in the process and where we are going.				

2. **If you disagreed with any of the above, please tell us why and how to improve:**

3. **Based on meetings held to date, do you have any suggestions for us that might improve the meetings or planning process? What have we missed? What do we need to cover in future? Please let us know:**

4. **If you have any other thoughts, concerns, or feedback, please tell us:**

5. **If you would like us to follow-up with you about any of your answers, please leave your name and phone number:**

THANK YOU!

`

Appendix F
Steering Committee Workshop 1
03-18-2024

OLD COLONY
PLANNING COUNCIL

Rebecca Coletta, President	Mary Waldron, Executive Director

(508) 583-1833 | 70 School Street, Brockton, MA 02301 | www.oldcolonyplanning.org

Regional Water Plan
Steering Committee Meeting
MINUTES OF THE MEETING
Monday, March 18, 2024, 9:00am

Location: Old Colony Planning Council, 70 School St, Brockton, MA 02301

Attendees:

Steering Committee	
Organization	**Name**
Town of Abington	Liz Shea
Town of Avon	Jonathan Beder
Town of Bridgewater	Shane O'Brien
Bridgewater Engineering	Greg Tansey
City of Brockton	Pat Hill
CPCWDC	Kimberly Groff
East Bridgewater	John Haines
Easton Department of Public Works	Greg Swan
Town of Kingston	Val Massard
MA Department of Conservation and Recreation	Jason Duff
Department of Marine Fisheries	Brad Chase (via Zoom)
MassDEP	Duane LeVangie
MassDEP	Jon Hobill (via Zoom)
MA State Senate	Al DeGirolamo (via Zoom)
Pembroke Water Department	Dan Sullivan
OCPC	Joanne Zygmunt
Town of Plympton	Gavin Murphy (via Zoom)
Watershed Associations	Pine duBois
Watershed Associations	Jimmy Powell (via Zoom)

Observers	
Organization	**Name**
South Shore Chamber of Commerce	Peter Forman
OCPC	Bill Napolitano
OCPC	Don Sullivan

OCPC	Mary Waldron (via Zoom)
OCPC Council, President	Becky Coletta

Consultants	
Organization	**Name**
CDM Smith	Dan Rodrigo
CDM Smith	Kirk Westphal
CDM Smith	Tarun Gill
CDM Smith	Amara Regehr
CDM Smith	Grace Inman
CDM Smith	Kara Rozycki (via Zoom)
Regina Villa Associates	Kyle Olsen

Minutes:

1. Call to Order, introductions
   a. Introduction provided on overview of the planning process. The main purpose of this workshop is to develop objectives
   b. Discussed feedback from last meeting. Reviewed engagement protocols that the group agreed upon.
2. Public Comment - none
3. Agreement on Guiding Principles
   a. Core values that stakeholders use to guide the development of the plan
   b. Reviewed draft guiding principles:
      i. Recommend sustainable water supply strategies that balance social, environmental, and economic needs for the region.
      ii. Align with values of good stewardship and wise use of water.
      iii. Reflect the limits of our natural resources and current/anticipated regulations.
      iv. Incorporate uncertainties so implementation of recommendations can adapt over time.
      v. Strive for equity and social justice within and among the communities.
      vi. Produce a list of “early-win” projects that can be aligned with available outside funding.
   c. Discussed potential revisions/additions:
      i. Ecosystem

ii. Local/regional communications

iii. State

iv. Uncertainty → adaptable plan

d. CDM Smith will revise based on feedback

4. Summary of Mapping Exercise

a. Reviewed regional themes from mapping exercise in last meeting: water quality, affordability, growing demand, climate change, maintaining or upgrading infrastructure, sustainable water supply, political support, funding realities, regulations, ecosystem health, and recreational issues.

5. Brainstorm Objectives

a. Quantity to meet need

b. Quality (especially to meet changing regulations, ie. PFAS)

c. Affordability

d. Balancing focus of supply and demand

e. Increasing demand (especially for MBTA housing requirements)

f. Differentiate between drinking water and ecosystem quality for other use goals

g. State's objectives vs. local objectives/local resource management

h. Infrastructure improvements / unaccounted for water

i. Stormwater and wastewater as a resource

j. Cost and timing of investment

k. Potential for partnership

l. Redundancy need

m. Public trust

n. Equity, social justice, and rates

o. Public communications on inter-community

p. Roadmap of where investments should be made

q. Water supply protection policies (ie. Salting)

r. Protection for degradation of existing resources. Consider MEPA and inter-basin transfer issues that would arise.

s. Resiliency

    i. Not having to worry to meet peak demand

    ii. Drought conditions and extreme precipitation

    iii. Difficulty of emergency declaration from administrative perspective

    iv. Coordinate with Drought Management Task Force

t. Public support from Board of Selectmen / Decision makers (who often serve as Water Commissioners)

    i. Will need a public education summary document

    ii. Plan will need specific next steps

6. Refinement of Objectives

    a. Meet all current and future peak water demands and existing sources of water supply

    b. Meet safe drinking water quality regulations, current and future

    c. Improve ecosystem health

    d. Prioritize alternatives with high cost-benefit value

    e. Promote equity by incorporating affordability, accessibility, and distribution of infrastructure impacts

    f. Consider innovative and alternative solutions such as stormwater, wastewater, and water use efficiency

    g. Encourage sustainable economic prosperity

7. Data Needs

    a. Still missing data from some communities

8. Upcoming Technical Work

    a. Annotated Bibliography will be distributed to each community for review

9. Preview of the Second Workshop and the first Public Meeting

    a. Public outreach communications plan being developed with OCPC, CDM Smith, and RVA. Will include various components: Public meetings, public consultation focus groups, stakeholder interviews, website/e-mail blasts, etc.

Action Items:

Assigned to	Action Item
Dan, Kirk, Amara	Update Steering Committee’s guiding principles and objectives

Amara	Update handout with the updated guiding principles, and definitions for guiding principles, objectives, and metrics for next meeting
Steering Committee members	Provide requested data, if not done
Steering Committee members	Review annotated bibliographies to be sent over next month for review

Attachments:

1. Meeting Presentation Slides
2. Meeting Sign-In Sheet
3. Feedback Survey
4. Definitions

Prepared by CDM Smith.

Attachment 1

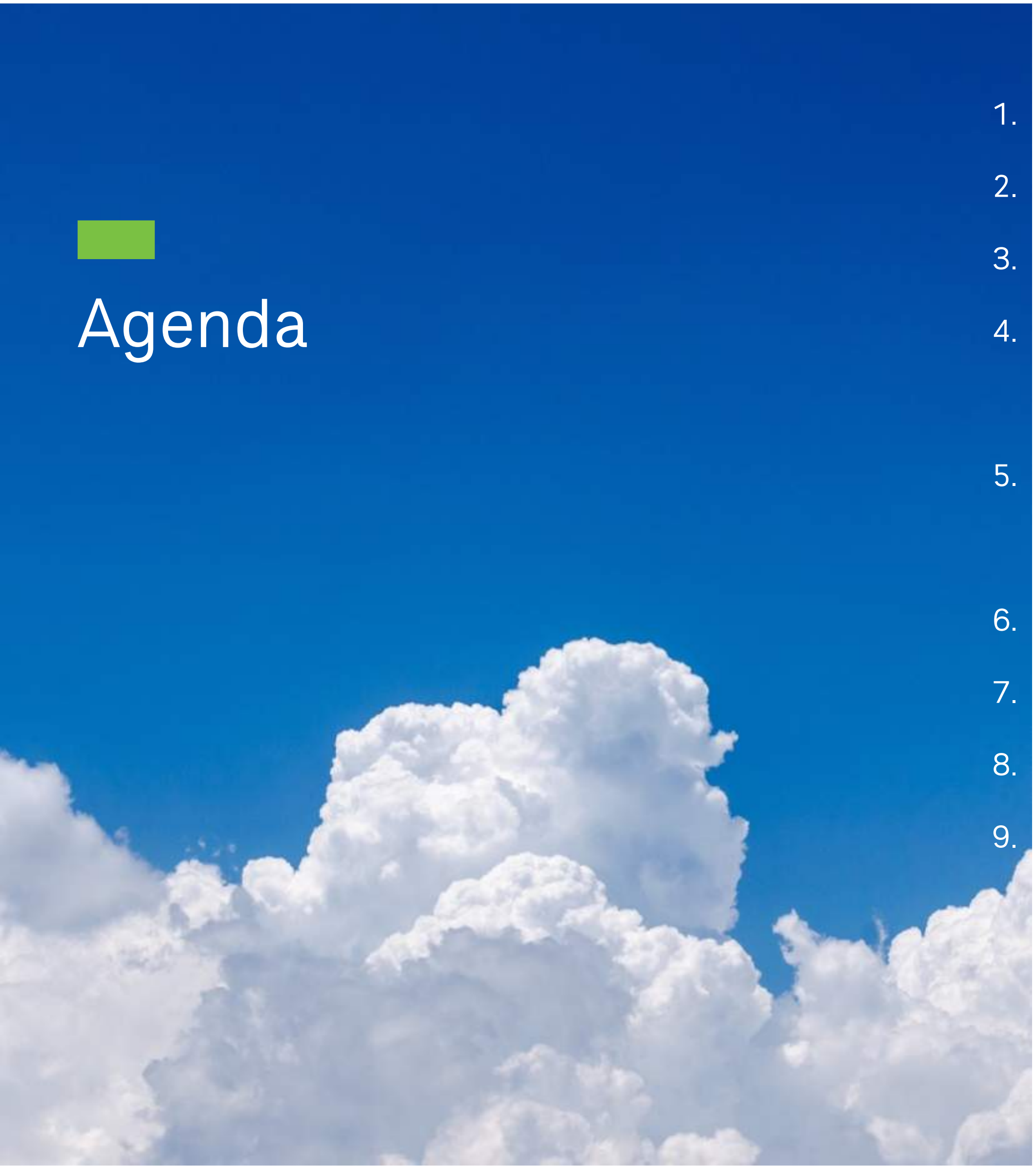
Old Colony Planning Council Regional Water Plan

Workshop 1

Economic Resilience and Sustainable Water Supply

Kirk Westphal, Dan Rodrigo, Kara Rozycki, Tarun Gill, Dan Rodrigo, and Amara Regehr

March 18, 2024



Agenda

1. Public Comment
2. Agreement on Guiding Principles
3. Summary of Mapping Exercise
4. Brainstorm Objectives

Coffee Break

5. Refinement of Objectives

Coffee Break

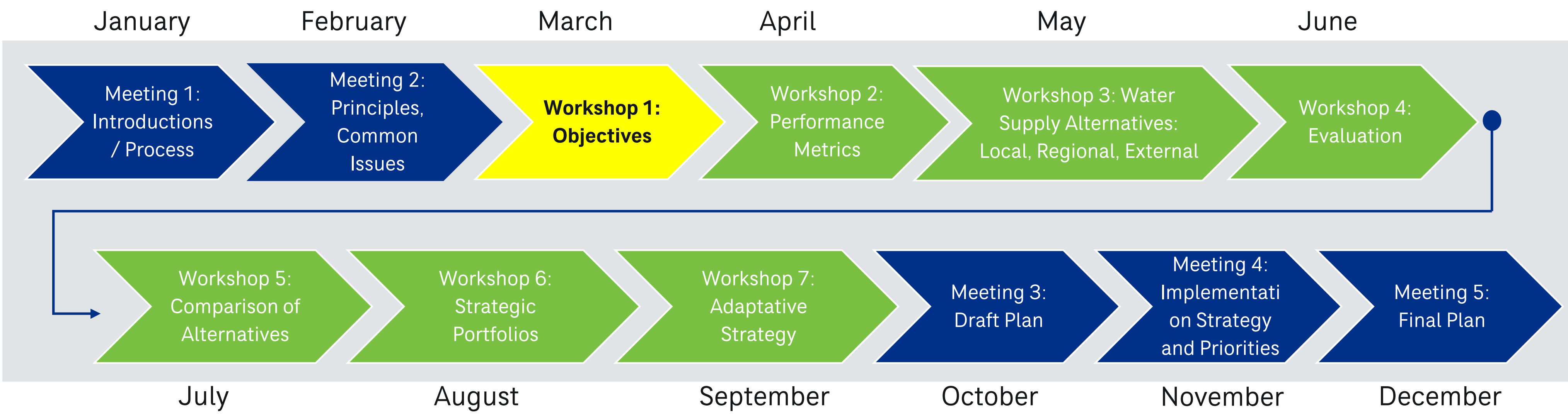
6. Data Needs
7. Upcoming Technical Work
8. Preview of Workshop Two and Public Meeting One
9. Feedback Survey

Introductions

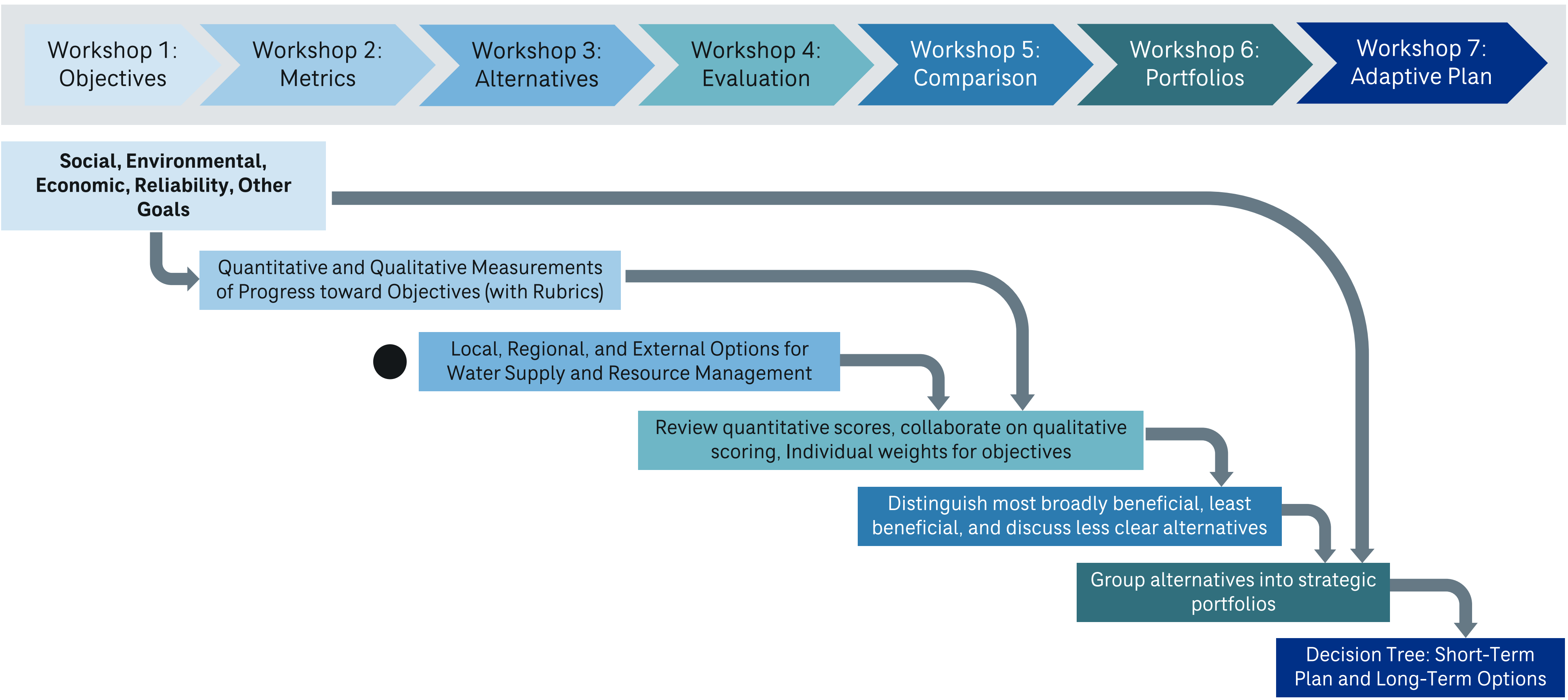
- Name
- Community or organization you are representing
- Position/Title

Public Comment

Overview of Regional Water Plan Process



Workshop Process

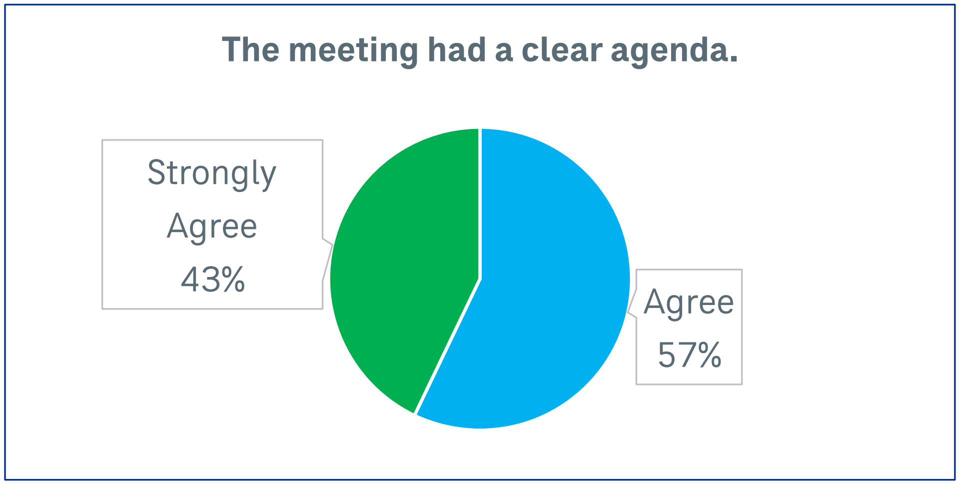


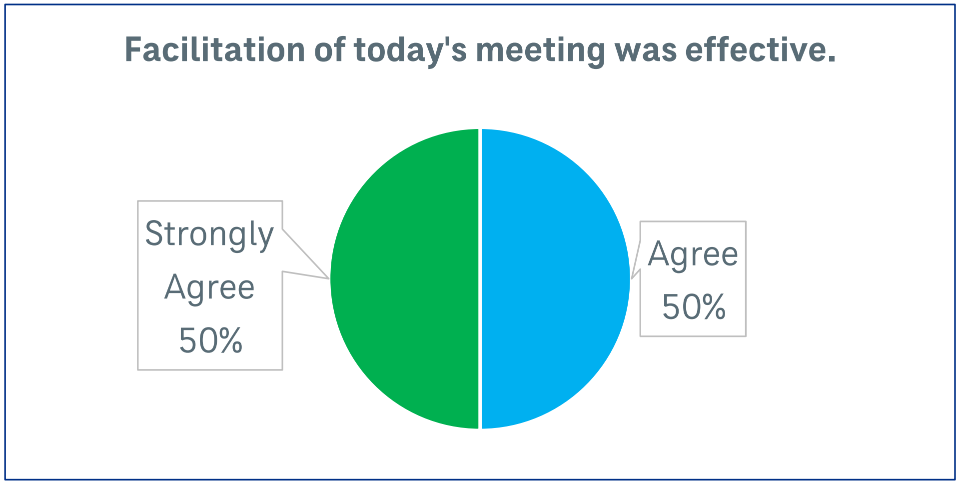
Last Meeting: Feedback Survey Results

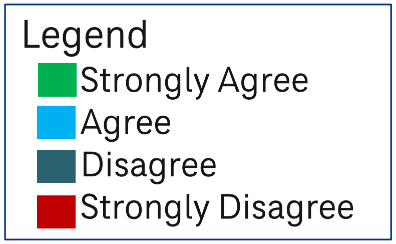
1. Please tick one box per row.
The meeting had a clear agenda.
Facilitation of today's meeting was effective.
I had plenty of opportunity to participate in the discussion today.
Interactions were positive and respectful.
I understand where we are in the process and where we are going.

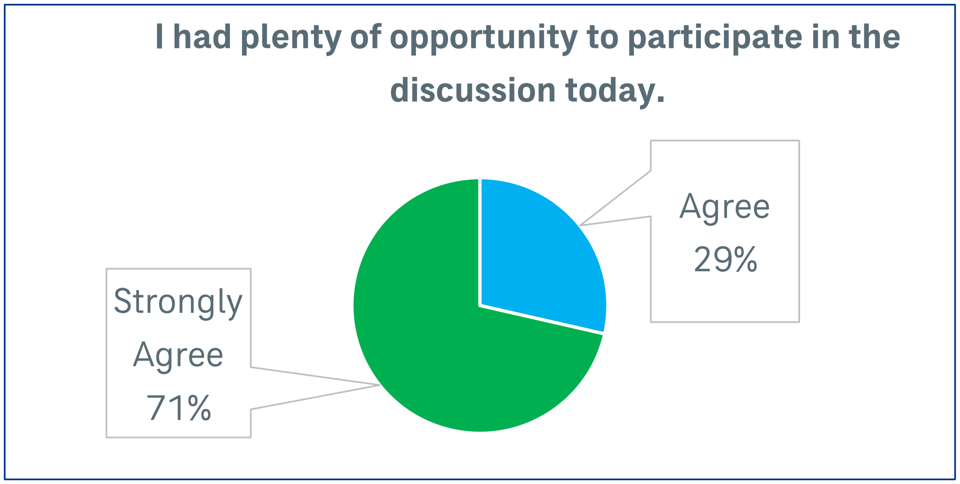
Strongly disagree	Disagree	Agree	Strongly agree

Last Meeting: Feedback Survey Results

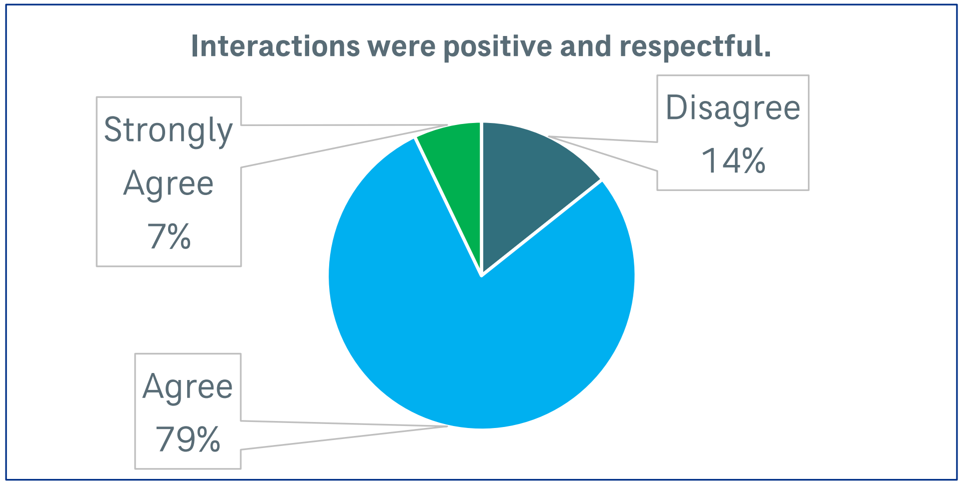


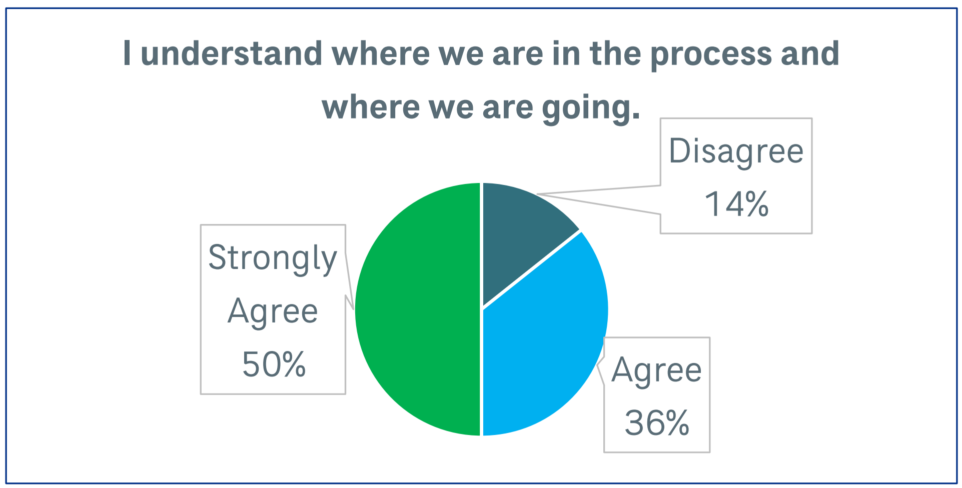






Last Meeting: Feedback Survey Results





Agreement on Guiding Principles

Definitions of Terms for Strategic Planning

Engagement Protocols	Guiding Principles
Objectives	Criteria / Metrics
Alternatives/ Strategies	Portfolios

Definitions of Terms for Strategic Planning

- **Engagement Protocols**
  - Defines how stakeholders will work together, rules for engagement, and what consensus means.

- **Guiding Principles**
  - Represent a set of core values that stakeholders use to guide the development of the plan, usually 3-5 statements that convey the following

- **Objectives**
  - Represent specific, measurable goals for the plan that are usually aligned to each guiding principle. There may be more than one objective for each guiding principle.

Definitions of Terms for Strategic Planning

- **Criteria or Metrics**
  - The specific measurements of success in meeting the objectives.
- **Alternatives / Strategies**
  - The proposed actions or combinations of actions that will be evaluated against criteria/metrics.
- **Portfolios**
  - The groupings of alternatives that are considered for the final plan.

Engagement Protocols

Engagement Protocols	We agree that there will be one voice for each organization.
	We will actively listen to others and take turns while speaking.
	We will represent our organizations, as well as those with similar challenges, and the region.
	Regulators will join us to provide feasibility insights, lessons from other regions, guardrails and their own education about the needs in the region.
	We will seek to arrive at a point where we can advocate for the plan.
	As a group, we will make recommendations, not necessarily decisions.
	We will be patient with the pace of this project.
	Debate and disagreement are part of this process, but they must be constructive, forward looking, and respectful.

Engagement Protocols Continued

Engagement Protocols	For resolving conflict:	We will recommend what we agree on, based on regional progress toward objectives.
		We will forge “pathways” for next steps on issues not resolvable within this timeframe.
		We will document opinions on all sides of unresolved issues in the plan.

Our Guiding Principles

1. Recommend sustainable water supply strategies that balance social, environmental, and economic needs for the region.
2. Align with values of good stewardship and wise use of water
3. Reflect the limits of our natural resources and current/anticipated regulations.
4. Incorporate uncertainties so implementation of recommendations can adapt over time.
5. Strive for equity and social justice within and among the communities.
6. Produce a list of “early-win” projects that can be aligned with available outside funding.

Summary of Mapping Exercise

Summary of Mapping Exercise

Water Quality	Affordability	Growing Demand	Climate Change
Maintaining or upgrading infrastructure	Sustainable water supply	Political Support	Funding realities
Regulations	Ecosystem Health	Recreational Issues	

Brainstorm Objectives

Brainstorm Objectives

Brainstorm Objectives

Coffee Break

Refinement of Objectives

Refinement of Objectives

Data Needs

Data Requests

- Abington
- Avon
- Bridgewater
- Brockton
- Duxbury
- East Bridgewater
- Easton
- Halifax
- Hanover
- Hanson
- Kingston
- Pembroke
- Plymouth
- Plympton
- Stoughton
- West Bridgewater
- Whitman
- Watershed Associations
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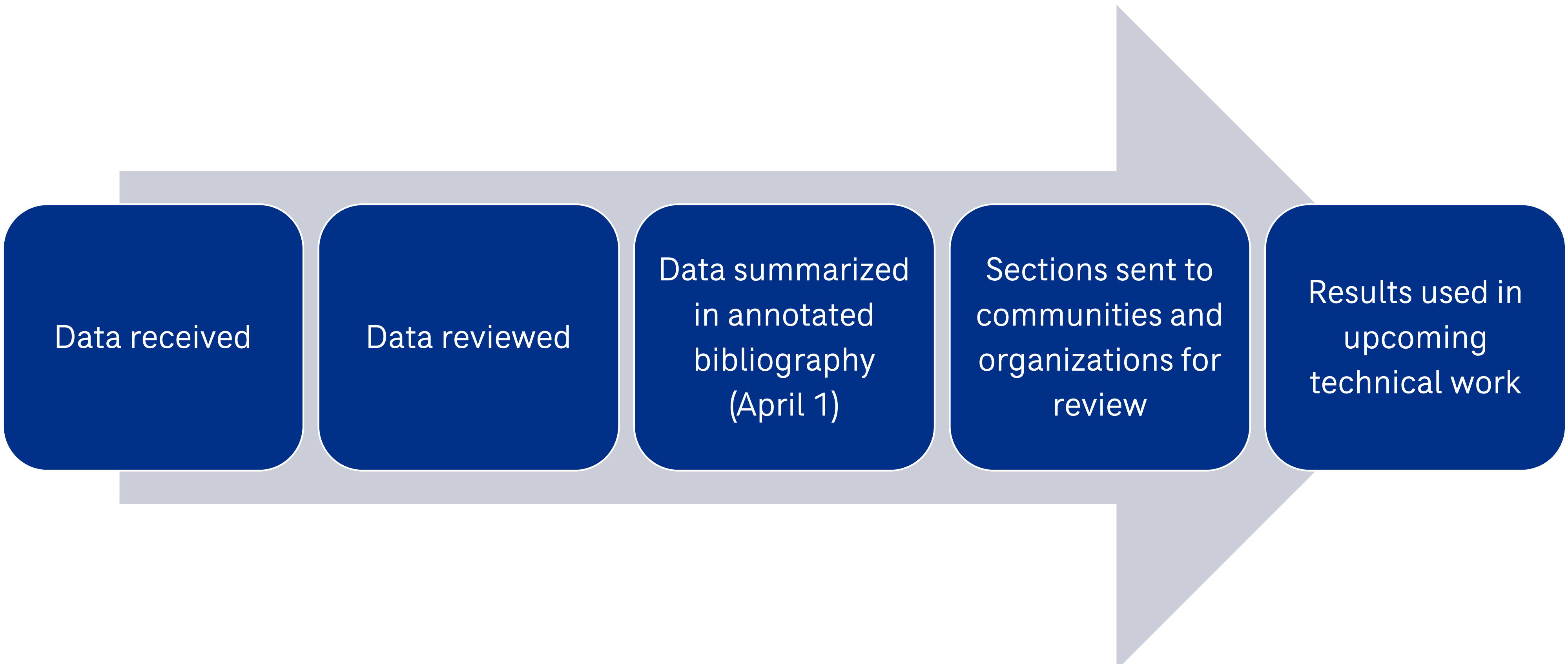
- Kingston
- Pembroke
- Plymouth
- Plympton
- Stoughton
- West Bridgewater
- Whitman
- Watershed Associations
- Central Plymouth County Water District Commission

Annotated Bibliography



Upcoming Technical Work

Upcoming Technical Work

- Annotated Bibliography
- Supply and Demand Gap Analysis
- Future Demand Projections
  - Combination of community projections, state projections, and our projections
  - Produced on the community and regional level
- Drought and Climate Risks
- Hydrologic Assessment

- Responding to technical requests from the steering committee

Preview of Workshop Two and Public Meeting One

Workshop Process

Workshop 1: Objectives → Workshop 2: Metrics → Workshop 3: Alternatives → Workshop 4: Evaluation → Workshop 5: Comparison → Workshop 6: Portfolios → Workshop 7: Adaptive Plan

Social, Environmental, Economic, Reliability, Other Goals

Next workshop:

- Identify quantitative and qualitative measurements of progress toward objectives
- Discuss relevant importance of objectives

Upcoming Schedule

WHEN	DETAILS
Tuesday, April 23rd 9:00 am – 12:00 pm	Workshop 2: Metrics
Monday, May 20th 9:00 am – 12:00 pm	Workshop 3
Tuesday, June 25th 9:00 am – 12:00 pm	Workshop 4
Wednesday July 31st 9:00 am – 12:00 pm	Workshop 5
Tuesday, August 27th 9:00 am – 12:00 pm	Workshop 6
Tuesday, September 24th 9:00 am – 12:00 pm	Workshop 7
Tuesday, October 29th 9:00 am – 12:00 pm	Meeting 3
Monday, November 18th 8:00 am – 12:00 pm	Meeting 4
Tuesday, December 10th 8:00 am – 12:00 pm	Meeting 5

Feedback Survey

Attachment 2

OLD COLONY PLANNING COUNCIL

Welcome to the

OCPC Regional Water Plan

Please sign in

NAME	EMAIL
Patrick Hill	Phill@cobma.us
Jason Duff	jason.duff@mass.gov
Kimberly Groff, CPCWDC Rep.	kimberlygroffma@gmail.com
Dan Sullivan	Dsullivan@TownofPembrokemass.org
Jonathan Beder	JBEDER@AVON-MA.GOV
Elizabeth Shea	eshea@abingtonma.gov
Duane LeVangie	duane.levangie@mass.gov
Wayne Parke	wparks@wbridgewater.com
Pine duBois	Pine@jonesriver.org
Val Massard	vmassard@kingstonma.gov
GREG TANSEY	gtansey@bridgewaterMA.ORG
John Haines	jhaines@eastbridgewaterma.gov
R. Gordon	Rgordon@plymouth-ma.gov
Greg Swan	GSWAN@EASTON.MA.US

OLD COLONY
PLANNING COUNCIL

Welcome to the

OCPC Regional Water Plan

Please sign in

NAME	EMAIL
Shane O'Brien	sobrien@bridgewaterma.org

Attachment 3

MEETING FEEDBACK

Please complete this short survey at the end of today's meeting/workshop and drop it in the box by the exit. Your feedback will help us ensure this project meets the needs of the region, municipalities, and other stakeholders as we move forward. We want to make sure we use your valuable time efficiently and effectively and include everyone in the process. **Results will be used by OCPC and CDM Smith internally only.**

1. **Please tick one box per row.**	Strongly disagree	Disagree	Agree	Strongly agree
The meeting had a clear agenda.				
Facilitation of today's meeting was effective.				
I had plenty of opportunity to participate in the discussion today.				
Interactions were positive and respectful.				
I understand where we are in the process and where we are going.				

2. **If you disagreed with any of the above, please tell us why and how to improve:**

3. **Based on meetings held to date, do you have any suggestions for us that might improve the meetings or planning process? What have we missed? What do we need to cover in future? Please let us know:**

4. **If you have any other thoughts, concerns, or feedback, please tell us:**

5. **If you would like us to follow-up with you about any of your answers, please leave your name and phone number:**

THANK YOU!

`

Attachment 4

OLD COLONY PLANNING COUNCIL

Rebecca Coletta, President | Mary Waldron, Executive Director

(508) 583-1833 | 70 School Street, Brockton, MA 02301 | www.oldcolonyplanning.org

Definitions for Decision-Making Terms used in Strategic Planning

1. Engagement Protocols –
    a. Defines how stakeholders will work together, rules for engagement, and what consensus means.
2. Guiding Principles –
    a. Represent a set of core values that stakeholders use to guide the development of the plan, usually 3-5 statements that convey the following:
        i. Why is the plan being done? What are the constraints to work within? What does success look like?
3. Objectives –
    a. Represent specific, measurable goals for the plan that are usually aligned to each guiding principle. There may be more than one objective for each guiding principle.
4. Criteria or Metrics –
    a. The specific measurements of success in meeting the objectives.
5. Alternatives/Strategies –
    a. The proposed actions or combinations of actions that will be evaluated against criteria/metrics.
6. Portfolios –
    a. The groupings of alternatives that are considered for the final plan.

Engagement Protocols: Listed below are our agreed upon engagement protocols for the steering committee. These define how we will work together over the course of this project.

- We agree that there will be one voice for each organization.
- We will actively listen to others and take turns while speaking.
- We will represent our organizations, as well as those with similar challenges, and the region.
- Regulators will join us to provide feasibility insights, lessons from other regions, guardrails, and their own education about the needs in the region.
- We will seek to arrive at a point where we can advocate for the plan.
- As a group, we will make recommendations, not necessarily decisions.
- We will be patient with the pace of this project.
- Debate and disagreement are part of this process, but they must be constructive, forward looking, and respectful.
- For resolving conflict:

- We will recommend what we agree on, based on regional progress toward objectives.
- We will forge "pathways" for next steps on issues not resolvable within this timeframe.
- We will document opinions on all sides of unresolved issues in the plan.

Guiding Principles: Listed below are the draft guiding principles for this project which were based on the discussion at the Steering Committee Meeting February 28, 2024. These represent a set of core values used to guide the development of the plan.

1. Recommend sustainable water supply strategies that balance social, environmental, and economic needs for the region.
2. Align with values of good stewardship and wise use of water.
3. Reflect the limits of our natural resources and current/anticipated regulations.
4. Incorporate uncertainties so implementation of recommendations can adapt over time.
5. Strive for equity and social justice within and among the communities.
6. Produce a list of "early-win" projects that can be aligned with available outside funding.

Objectives, Alternatives and Strategies, and Portfolios will be developed by the Steering Committee and CDM Smith throughout the course of this project, using the guiding principles to accomplish the vision statement.

Appendix F
Steering Committee Workshop 2
03-18-2024

OLD COLONY
PLANNING COUNCIL

Rebecca Coletta, President | Mary Waldron, Executive Director

(508) 583-1833 | 70 School Street, Brockton, MA 02301 | www.oldcolonyplanning.org

Regional Water Plan
Steering Committee Meeting
MINUTES OF THE MEETING
Tuesday, April 23, 2024, 9:00am

Location: Old Colony Planning Council, 70 School St, Brockton, MA 02301

Attendees:

Steering Committee	
Organization	**Name**
Town of Abington	Liz Shea
Town of Avon	Jonathan Beder
Town of Bridgewater	Shane O'Brien
CPCWDC	Art Edgerton
CPCWDC	Kimberly Groff
East Bridgewater	John Haines
Easton Department of Public Works	Greg Swan
EPA	Margherita Pryor (via Zoom)
Town of Kingston	Val Massard
MA Department of Conservation and Recreation	Jason Duff
MAPC	Martin Pillsbury (via Zoom)
MassDEP	Duane LeVangie
MassDEP	Jon Hobill (via Zoom)
Pembroke Water Department	Dan Sullivan
OCPC	Joanne Zygmunt
Town of Plympton	Gavin Murphy (via Zoom)
Town of Plympton	Brian Vasa (via Zoom)
Town of Stoughton	Phil McNulty
Watershed Associations	Pine duBois
Watershed Associations	Jimmy Powell (via Zoom)

Observers	
Organization	**Name**
South Shore Chamber of Commerce	Peter Forman (via Zoom)
OCPC	Bill Napolitano

Consultants	
Organization	**Name**
CDM Smith	Al LeBlanc
CDM Smith	Kirk Westphal
CDM Smith	Amara Regehr
CDM Smith	Grace Inman
CDM Smith	Kara Rozycki
Regina Villa Associates	Kyle Olsen

Minutes:

1. Call to Order, introductions
2. Public Comment – none
3. PFAS
    a. Presentation by Al LeBlanc, followed by Q&A:
    b. Is reactivating carbon an option versus disposal? Cost difference? ~$2/pound for carbon to purchase but ~$4/pound for carbon to purchase and reactivate. Carbon life can range from 3-6 months to 3 years
    c. Is there a market for shipping carbon out for reactivation? Yes, likely.
    d. How are removed materials treated after removal from water? Incinerate or landfill
    e. Home treatment for private wells? These systems are expensive. Would need to a call a provider to get system and operating cost, including cost of carbon disposal.
    f. Source of PFAS in rural areas? Soil does not seem to stop it, still gets into the groundwater. Source can range from septic systems to agricultural, etc.
    g. Movement to control use of PFAS in consumer products? Yes, but potentially still have toxic replacement compounds.
    h. Are consumer systems worth it? Up to individual consumer. There is guidance from EPA on point of use systems. Need to use reputable provider for systems.
    i. Future regulations for other contaminants? Likely, but could be years away. PFAS treatment has additional benefits for removal of other contaminants. For example, Reverse Osmosis can help with pharmaceuticals (less so with Granular Activated Carbon).
    j. Operator difficulty for PFAS treatment systems? GAC easier to manage than RO
    k. Has DEP considered re-classification of operators? Unsure.
    l. Bottled water regulated? Less regulated than municipal water systems
    m. Long range housing initiatives and future of PFAS treatment? Potentially more centralized treatment facilities instead of many smaller systems

n. Faucet filters? Home water systems have failed with misuse on consumer end
o. Can private wells be regulated? Typically they are not, but Board of Health could require testing at time of sale, similar to Title 5 septic systems.
p. GAC contact time required? ~10 minutes, which is why refrigerator filters are not effective in removing PFAS

4. Metrics Examples

    a. Metrics to be created for each objective. Reviewed examples, prioritizing quantitative metrics where feasible.

5. Metrics Discussion

    a. Breakout Group D Metrics Discussed:

        i. Encourage sustainable water use to meet the needs for housing and economic prosperity.

            1. One metric for private well households: permitting for well re-digging. Track this on a regional scale to understand if there is no longer sustainable water supply
            2. Another metric: additional water supply potential for economic development
            3. May have limited data availability for this, would require measuring groundwater levels and surface water levels.
            4. Ideas came up about how to incorporate recommendations for final water plan
            5. Look at per capita water use- good indicator for if there is additional water
            6. Unaccounted for water (UAW)- trends for this
            7. Housing density efficiencies for water use – no specific metric mentioned
            8. Conserved land that is left for water recharge
            9. Public private partnerships
            10. Peak demand may not be a good metric to understand “cushion” for economic development
            11. High cost of water as a consideration for reclaimed water
            12. Drought restrictions could be an indicator for some communities while others go under drought restrictions every year so would not be a useful
            13. We also mentioned having some understanding of what is meant by sustainable supply

    b. Breakout Group C Metrics Discussed:

        i. Consider innovative and alternative solutions such as stormwater capture, wastewater reuse and water use efficiency.
            1. Consensus that water use efficiency is the most useful
            2. RGPCD is a measure of efficiencies
            3. UAW is a measure of efficiency

        4. Seasonal water use- to understand how much is being used for landscaping and nonessential uses
        5. Cost of solutions
        6. Ranking efficiency (efficiency = 4/5, traditional source (e.g. MWRA) = 2/3, wastewater reuse = 1)
        7. Stormwater was considered as the least likely alternative- lowest on priorities
    ii. Prioritize alternatives with high cost-benefit value.
        1. Efficiency would be considered highest cost benefit value
        2. Potential benefits from regional alternatives for high cost benefit value
        3. Wastewater reuse isn't cost effective
        4. Potential metric $/ gallon in efficiency or $/gallon in water sourced, applied to different uses

c. Breakout Group B Metrics Discussed:
    i. Promote equity by incorporating affordability, accessibility and distribution of infrastructure impacts.
        1. Equal access to goods= clean drinking water
        2. Impacts of infrastructure don't impact more communities than others
        3. Affordability- making sure that one community isn't paying significantly more than another community. But each community is it's own separate system
        4. Potentially use something like Household Burden Index – evaluate the cost of water compared to income
        5. Difference between regional and local equity- equity between communities versus within the same community
        6. If there are going to be groups of projects that are going to benefit the region as a whole, where are those projects going to take place?
        7. Potential to assess comparing gaps between supply and demand- but difficult due to interconnections
        8. Potentially look at RGPCD
        9. Try to ensure federal and state government funding can be spread throughout the region
        10. Consider the equity issue between private well owners and public water supply users
    ii. Meet current and future safe drinking water quality.
        1. Scale (low) = not meeting required water quality standards, medium = meeting required drinking water quality standards, high = exceeding required water quality standards

d. Breakout Group A Metrics Discussed:
    i. Meet all current and future peak water demands with climate resilient supply side and demand side strategies.
        1. Only focusing on the end user of the water supply: delivering water as a percent of demand for the region
        2. Resiliency within that supply on a regional scale- built in capacity – based on a specific goal to be determined- example of 20% buffer for climate resiliency

ii. Improve ecosystem health.
    1. Groundwater levels
    2. Streamflows
    3. Connectivity of different water bodies
    4. Fish migration patterns
    5. We are probably below what we should be for a healthy ecosystem. Should use different parameters to have an ecosystem index. Track over time, and have metrics based off of positive trend on ecosystem index. May be able to use MA state data related to this, or set for our own region

6. Metrics Finalization
    a. Reviewed discussions from breakout sessions. Metrics discussions will be continued at next workshop.
7. Annotated Bibliography
    a. Annotated Bibliography was distributed via email. Each community/association is requested to review their section and respond to questions at the end of their section. Send responses via email to Kara Rozycki (RozyckiKM@cdmsmith.com).
8. Regional Schematic
    a. Review of Sankey Diagram
        i. Overview of diagram provided
        ii. CDM Smith will review the diagram with MassDEP to clarify values
        iii. SC requested more details and description
    b. Review of schematic map
        i. SC requested more details and description. Clarify between water source and pipe interconnections.
9. Demand Projections
    a. To be discussed in upcoming workshops
10. Next Workshop
    a. 5/20/2024

Action Items:

Assigned to	Action Item
Steering Committee members	Review annotated bibliographies and respond to questions
Kara Rozycki	Email Annotated Bibliography questions to each steering committee member
CDM Smith	Review Sankey figure diagrams with MassDEP

Attachments:

1. Meeting Presentation Slides

Prepared by CDM Smith.

Old Colony Planning Council Regional Water Plan

Workshop 2

Economic Resilience and Sustainable Water Supply

Kirk Westphal, Amara Regehr, Kara Rozycki, Tarun Gill, Al LeBlanc

April 23, 2024

OLD COLONY PLANNING COUNCIL

EDA U.S. ECONOMIC DEVELOPMENT ADMINISTRATION

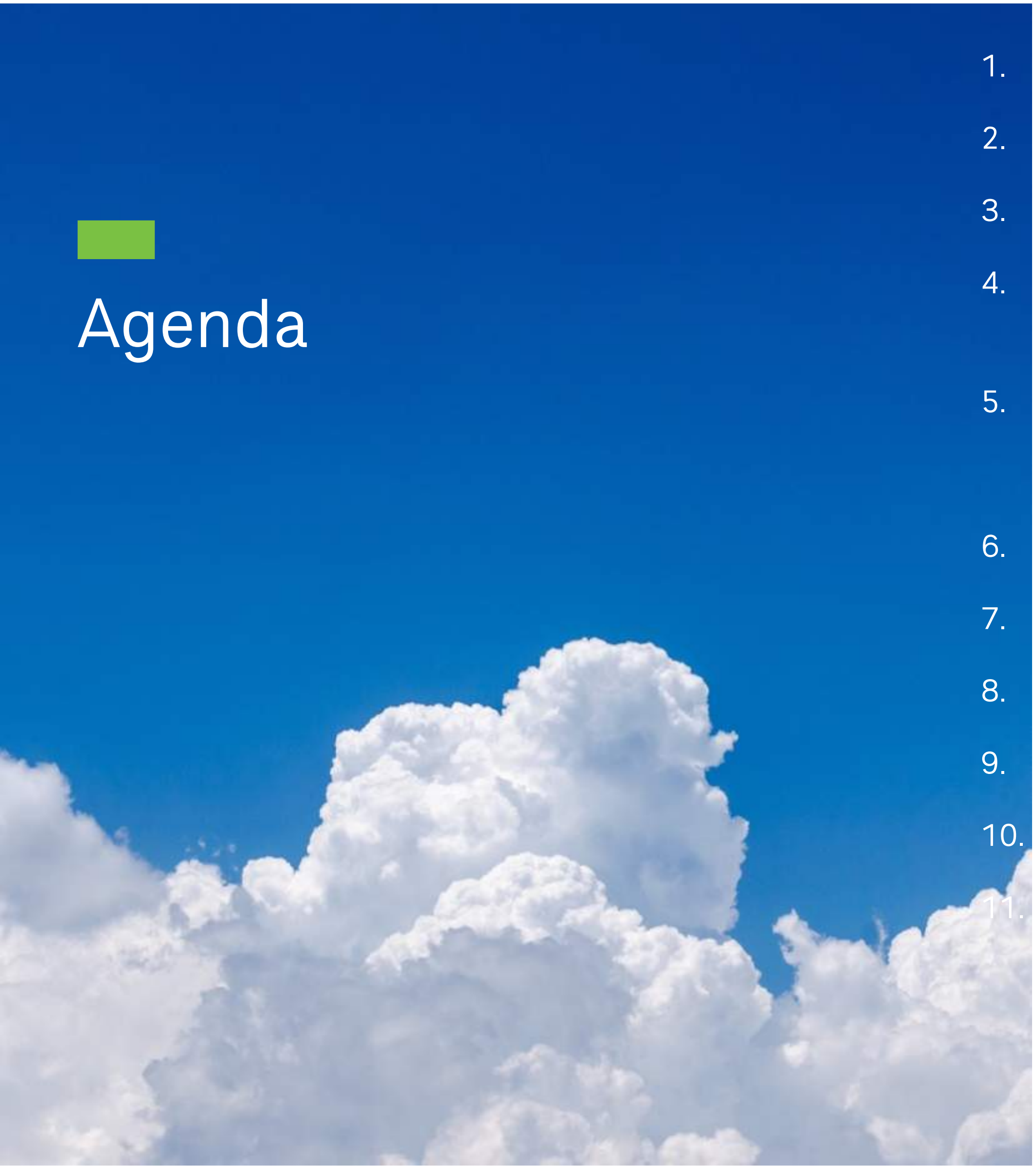
Central Plymouth County Water District Commission

SOUTH SHORE CHAMBER OF COMMERCE

CDM Smith

RVA

Alliance for Water Efficiency



Agenda

1. Call to Order
2. Public Comment
3. Guest Speaker Al LeBlanc: A Technical Overview of PFAS
4. Review of Our Process, Objectives, and Examples of Metrics from Other Regions
5. Break-Out Groups: Proposed Metrics and Rubrics

Coffee Break

6. Full Group Finalization of Metrics
7. Annotated Bibliography
8. Regional Schematic
9. Demand Projections
10. Next Workshop
11. Feedback Survey

Public Comment

Guest Speaker: PFAS

Final PFAS National Primary Drinking Water Regulation

EPA United States Environmental Protection Agency

Search EPA.gov

Environmental Topics | Laws & Regulations | Report a Violation | About EPA

Safe Drinking Water Act

CONTACT US

Per- and Polyfluoroalkyl Substances (PFAS)

Final PFAS National Primary Drinking Water Regulation

- Summary
- Supporting Materials
  - General Information
  - Communications Toolkit
  - Technical Information for States, Tribes and Water Systems
  - Español
- Regulatory Information and Supporting Documents
- Webinar Registration
- Background

Summary

On April 10, 2024, EPA announced the final National Primary Drinking Water Regulation (NPDWR) for six PFAS. To inform the final rule, EPA evaluated over 120,000 comments submitted by the public on the rule proposal, as well as considered input received during mul stakeholder engagement activities held both prior to and following the proposed rule. EPA expects that over many years the final rule will prevent PFAS exposure in dri 100 million people, prevent thousands of deaths, and reduce tens of thousands of serious PFAS attributable illnesses.

EPA is also making unprecedented funding available to help ensure that all people have clean and safe water. In addition to today's final rule, $1 billion in newly availab Infrastructure Law to help states and territories implement PFAS testing and treatment at public water systems and to help owners of private wells address PFAS contai

EPA finalized a National Primary Drinking Water Regulation (NPDWR) establishing legally enforceable levels, called Maximum Contaminant Levels (MCLs), for six PFAS i PFHxS, PFNA, and HFPO-DA as contaminants with individual MCLs, and PFAS mixtures containing at least two or more of PFHxS, PFNA, HFPO-DA, and PFBS using a Haz the combined and co-occurring levels of these PFAS in drinking water. EPA also finalized health-based, non-enforceable Maximum Contaminant Level Goals (MCLGs) fo

EPA announces first-ever national regulations for "forever chemicals" in drinking water

PUBLIC HEALTH

EPA puts limits on 'forever chemicals' in drinking water

APRIL 10, 2024 · 5:01 AM ET

HEARD ON MORNING EDITION

Pien Huang

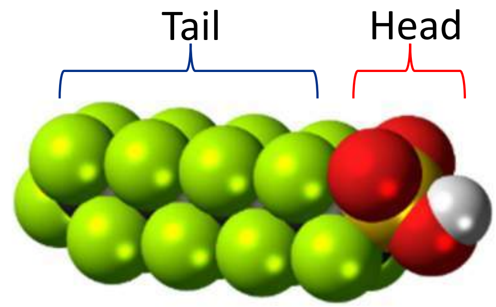
AP

CLIMATE

Biden administration sets first-ever limits on 'forever chemicals' in drinking water

UCMR5 data suggests 10,000 treatment facilities will need to be built potentially costing more than $40B in capital investment. The 5 year window is going to help, but this will still be a sprint to overcome workforce, supply chain, and other issues.

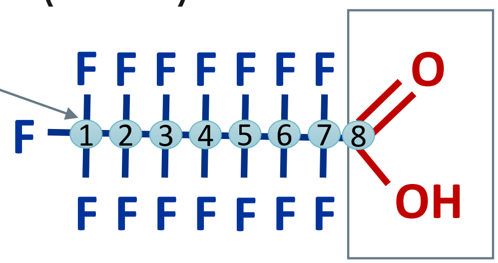
Emerging Contaminant - PFAS Overview



- ***P**er*- and *Poly*-***F**luoro**A**lkyl **S**ubstances (PFAS)

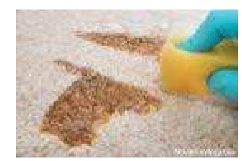
- ***P**er**F**luoro**O**ctanoic **A**cid (PFOA)

Strong carbon & fluorine bond

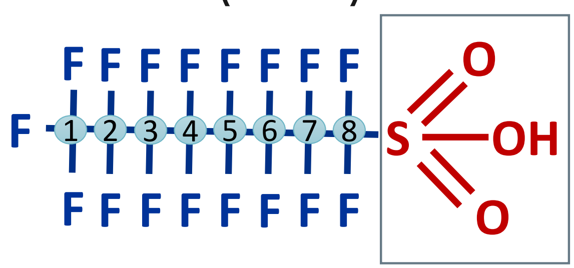


Carboxylate



- ***P**er**F**luoro**O**ctane**S**ulfonic Acid (PFOS)



Sulfonate

PFAS Vocabulary

- Long-chain and short-chain
- Carboxylates and sulfonates

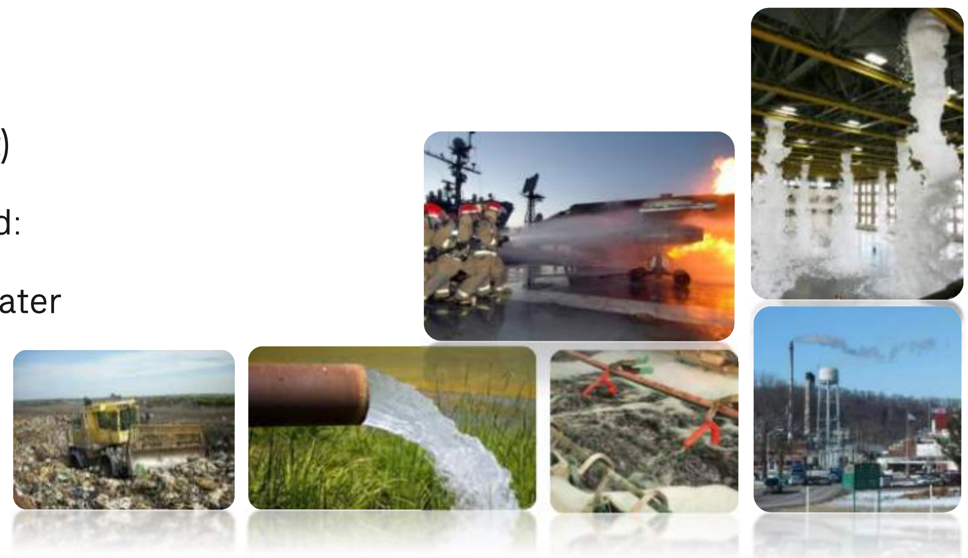
PFAAs	C4	C5	C6	C7	C8	C9	C10	C11	C12
Carboxylates	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnA	PFDoA
Sulfonates	PFBS	PFPeS	PFHxS	PFHpS	PFOS	PFNS	PFDS	PFUnS	PFDoS

Short-Chain PFAS

Long-Chain PFAS

PFAS Sources and Exposures

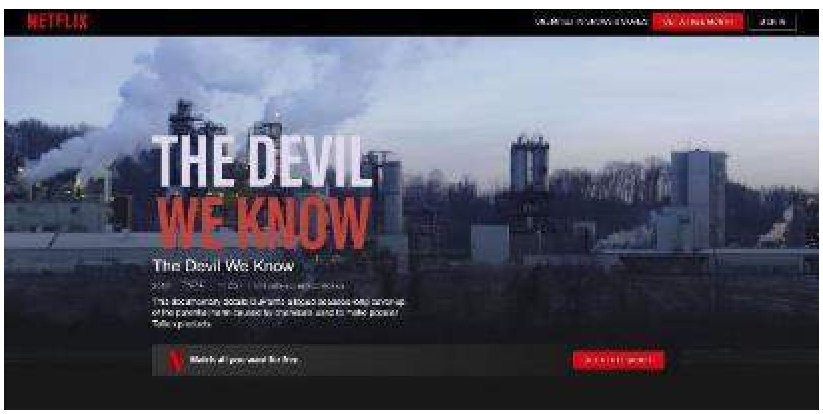
- Facilities using or storing aqueous film forming foams (AFFF), such as DoD installations, airports, oil refineries, fire training facilities, fire stations, etc.
- Manufacturing air emissions
- Chrome plating (PFOS as mist suppressant)
- Other areas where PFAS has been detected:
  - Landfill leachates, Wastewater, Stormwater

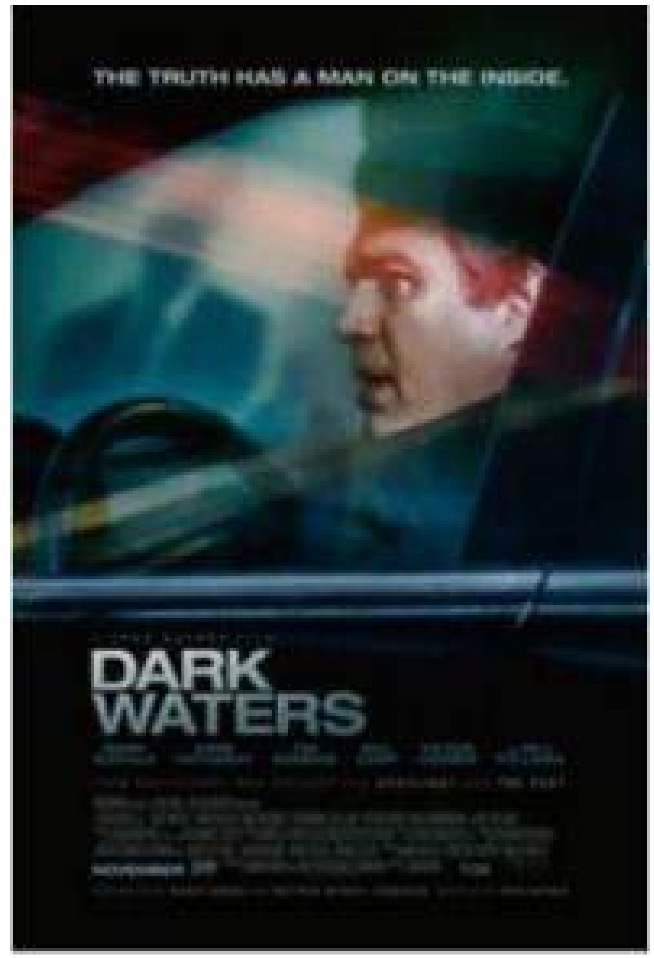


- PFAS in daily life

Regulatory Environment and Consumer Expectations

- 2009 Health Advisories:
  - PFOA at 400 ppt; PFOS at 200 ppt
- 2016 Revised Heath Advisories:
  - PFOA at 70 ppt; PFOS at 70 ppt
- June 2022 Health Advisories
- March 14, 2023 Draft MCLs
- April 10, 2024 Final MCLs
- Public push for more stringent levels in drinking water





Final EPA National Primary Drinking Water Regulations

Parameter	Maximum Contaminant Level Goal (MCLG)	Maximum Contaminant Level (MCL)
PFOA	0	**4.0 ppt**
PFOS	0	**4.0 ppt**
PFNA	10 ppt	10 ppt
PFHxS	10 ppt	10 ppt
GenX (HFPO-DA)	10 ppt	10 ppt
Mixture of 2 or more: PFNA, PFHxS, GenX, PFBS	Hazard Index (HI) of 1	HI of 1

- PFOA and PFOS levels did not change from draft MCL
- Remains the most challenging part of the rule for many water systems to comply with
- EPA Quote: *"lowest levels that are feasible for effective implementation"*

Final EPA National Primary Drinking Water Regulations

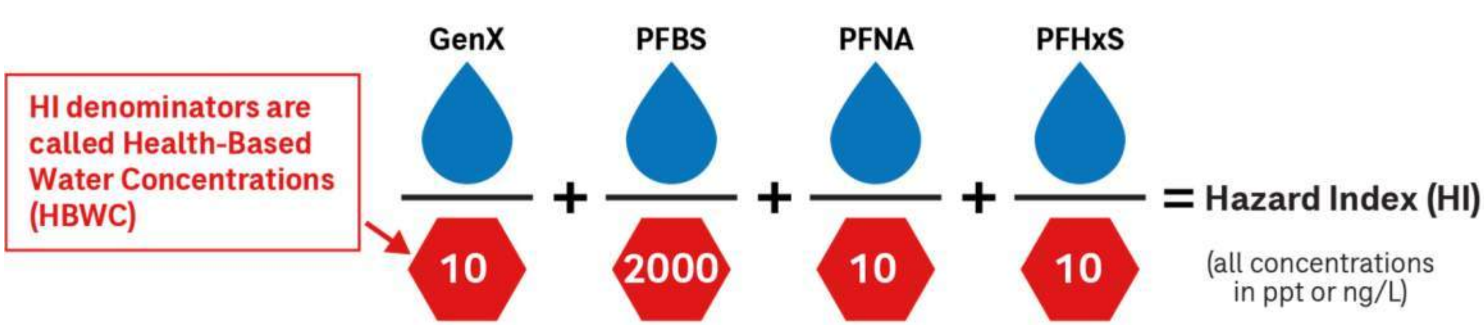
Parameter	Maximum Contaminant Level Goal (MCLG)	Maximum Contaminant Level (MCL)
PFOA	0	4.0 ppt
PFOS	0	4.0 ppt
PFNA	10 ppt	**10 ppt**
PFHxS	10 ppt	**10 ppt**
GenX (HFPO-DA)	10 ppt	**10 ppt**
Mixture of 2 or more: PFNA, PFHxS, GenX, PFBS	Hazard Index (HI) of 1	HI of 1

- New MCLs (previously only included in the HI)
- Compliance for these three MCLs is to one significant figure

Examples: Measured value of 14.9 ppt rounds to 10 ppt (one significant figure) = **Compliance**
Measured value of 15.0 ppt rounds to 20 ppt (one significant figure) = **Violation**

Final EPA National Primary Drinking Water Regulations

Hazard Index (HI) is used when two or more of these PFAS are present



- Compliance changed from “1.0” (draft rule) to “1” (final rule)
  - Is the change significant?

Final EPA National Primary Drinking Water Regulations

Example 1 – Water A: 134 ppt of PFBS,14.1 ppt of PFHxS, & non detect (ND) for GenX and PFNA

$$\underbrace{\frac{0}{10}}_{\text{GenX}} + \underbrace{\frac{134}{2000}}_{\text{PFBS}} + \underbrace{\frac{0}{10}}_{\text{PFNA}} + \underbrace{\frac{14.1}{10}}_{\text{PFHxS}} = 1.477$$

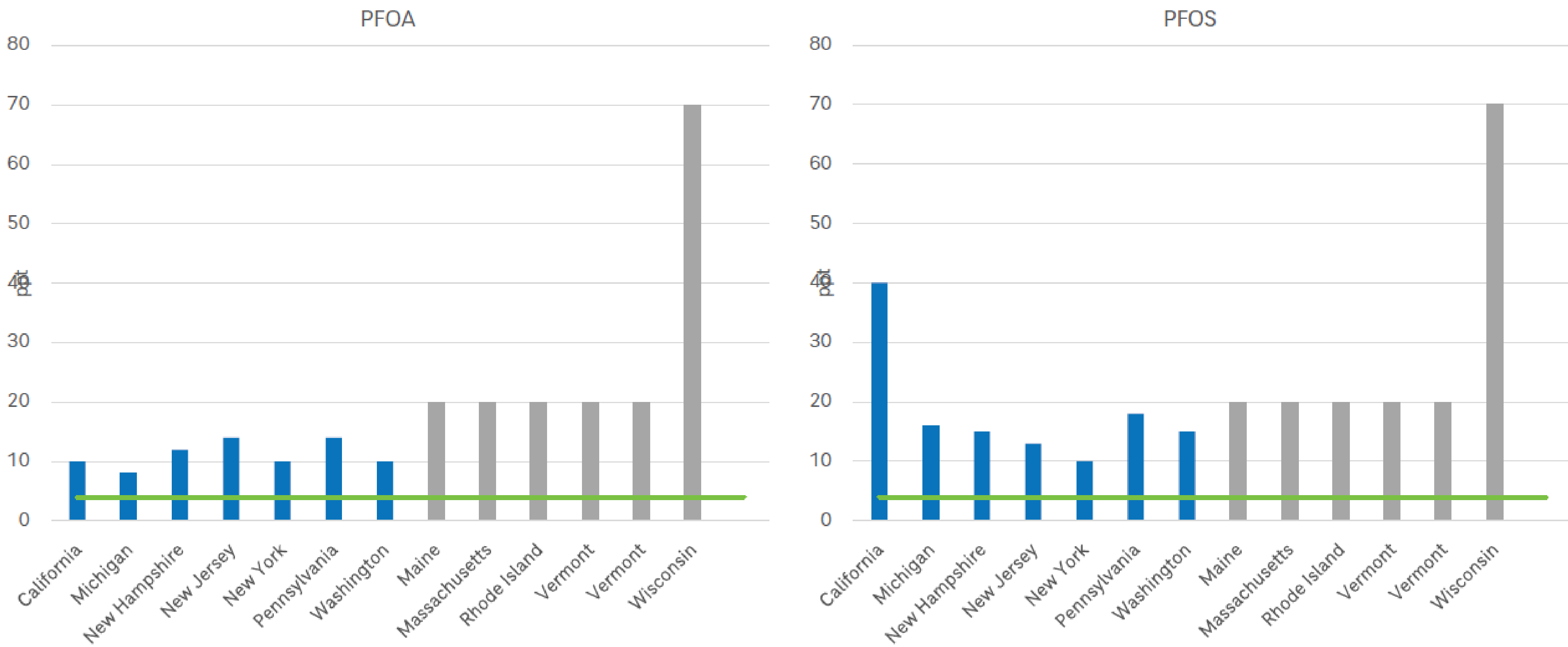
Rounds to 1 = Compliance

Example 2 – Water B: 6.3 ppt of GenX, 7.3 ppt of PFNA,4.8 ppt of PFHxS & ND for PFBS

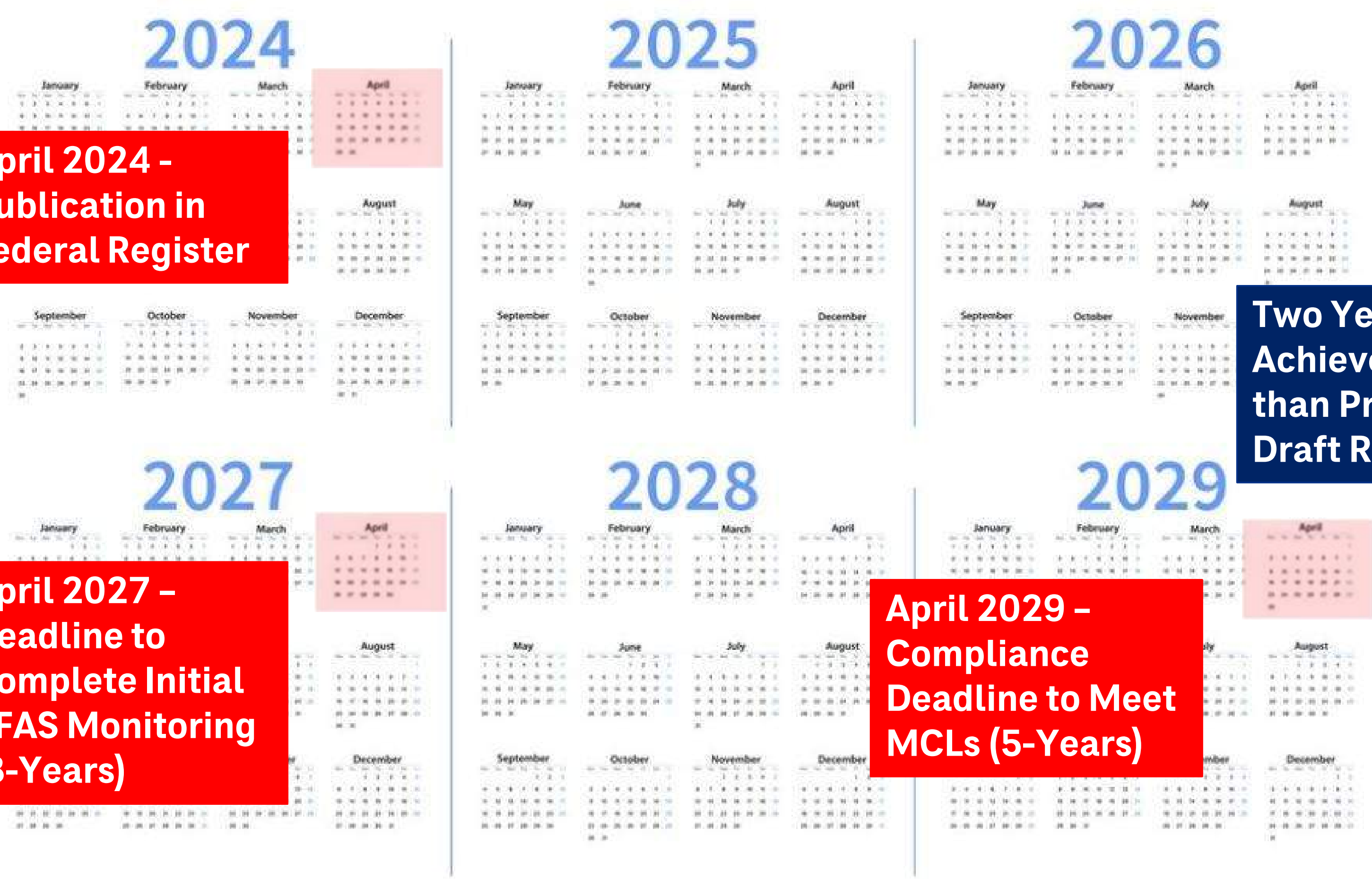
$$\underbrace{\frac{6.3}{10}}_{\text{GenX}} + \underbrace{\frac{0}{2000}}_{\text{PFBS}} + \underbrace{\frac{7.3}{10}}_{\text{PFNA}} + \underbrace{\frac{4.8}{10}}_{\text{PFHxS}} = 1.84$$

Rounds to 2 = Violation

Comparison to Promulgated State Regulations



Compliance Schedule



April 2024 - Publication in Federal Register

April 2027 – Deadline to Complete Initial PFAS Monitoring (3-Years)

April 2029 – Compliance Deadline to Meet MCLs (5-Years)

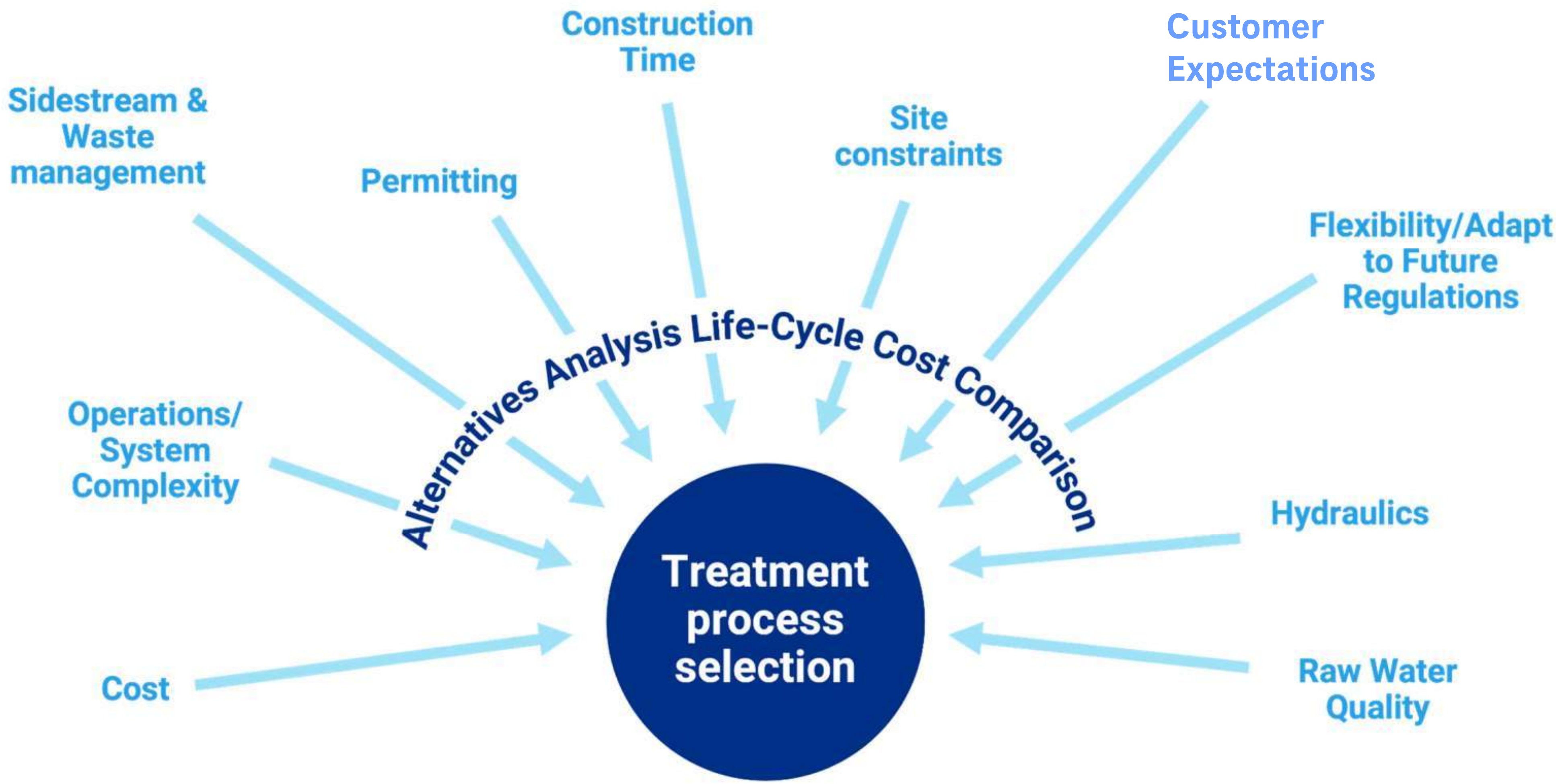
Two Years Longer to Achieve Compliance than Proposed in Draft Rule

Typical PFAS Project Implementation Steps

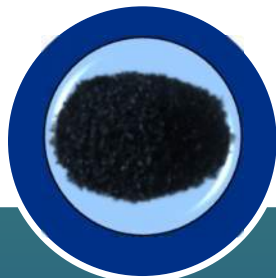
Traditional Delivery

	Activity	Common Duration
1	Gather/Review Data and Prepare Concept Memo	3 months
2	Bench Scale Testing	>=4 months
3	Pilot testing (if needed)	3-12 months
4	Design and Permitting	4-12 months
5	Bidding and Contract Award	2 months
6	Construction and Commissioning	15-36 months

- Project complexity and state regulatory requirements will affect timeline
- Concurrent performance of testing and design activities is possible
- Alternative project delivery methods can accelerate project schedule!
  - Design-build
  - Equipment/vessel pre-purchase


Construction Time
Customer Expectations
Sidestream & Waste management
Permitting
Site constraints
Flexibility/Adapt to Future Regulations
Alternatives Analysis Life-Cycle Cost Comparison
Operations/ System Complexity
Hydraulics
Treatment process selection
Cost
Raw Water Quality

Three Mainstream PFAS Treatment Technologies



Granular Activated Carbon (GAC)

Ion Exchange Resin

Reverse Osmosis Membranes

PFAS are NOT removed appreciably by conventional drinking water treatment. High doses of Powder Activated Carbon (PAC) can assist removal.

PFAS Removal for a Typical Groundwater Supply

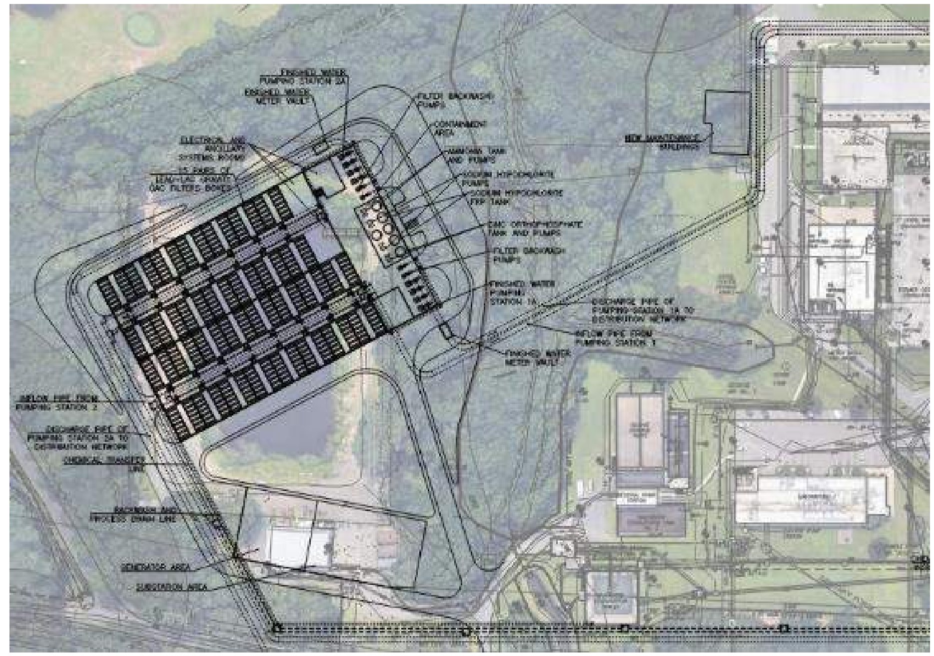
Owen District Road Water Treatment Plant
Westfield, Massachusetts

Key Points:

- Successful bench-scale test
- Three years (450 MG) of removing over 200 ppt to non-detect
- Rapid execution & schedule efficiency

PFAS Removal at Typical Surface Water Supply

Confidential Client
Eastern United States



Key Points:

- >100-mgd surface water supply with low level PFAS
- Filter retrofit vs. post filter treatment alternatives
- Rigorous technology evaluation & alternative analysis

PFAS Removal with Anion Exchange

Key Points:

- Less contact time required = Less Media = Lower Vessel Height
- Finer media requires upstream protection for resin

In this Photograph:

- Two 12-ft diameter AIX vessels
- Two bag filters
- Two chemical systems (calcium thiosulfate & zinc orthophosphate)

PFAS Removal with Reverse Osmosis (RO)

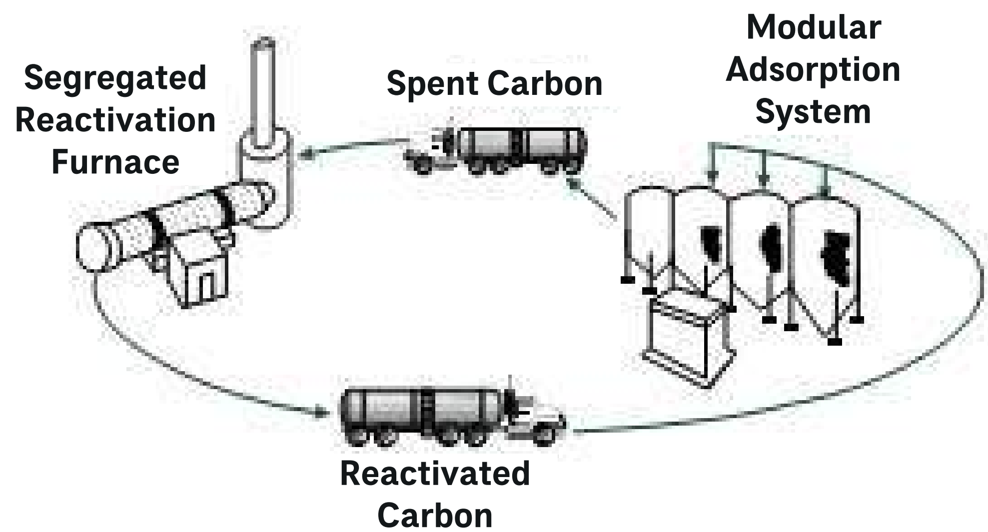
- Advantage:
  - Removal of co-contaminants
- Disadvantage:
  - Discharge of concentrated PFAS waste
  - High energy usage

Brunswick County	LPRO	Ozone/ O3 BAF – GAC	GAC/IX/UV -AOP
Total Capital Costs	$ 99 M	$ 99 M	$ 84 M
25-yr Present Worth Annual Costs	$ 59 M	$ 95 M	$ 93 M
Total 25-yr Capital + Annual O&M	**$ 158 M**	$ 194 M	$ 177 M

Brunswick County, NC Surface Water Treatment RO Facility (41-mgd capacity)

The Source and Fate of Spent Media

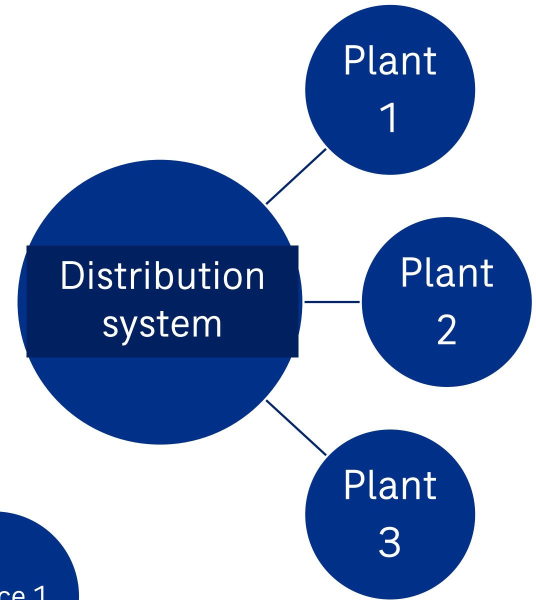
- Granular Activated Carbon
  - Mined then "activated"
  - Landfill
  - Incineration
  - Reactivation / Reuse of Carbon
- Single Use Anion Exchange Resin
  - Manufactured
  - Landfill
  - Incineration
  - No re-use of Anion Exchange Resin

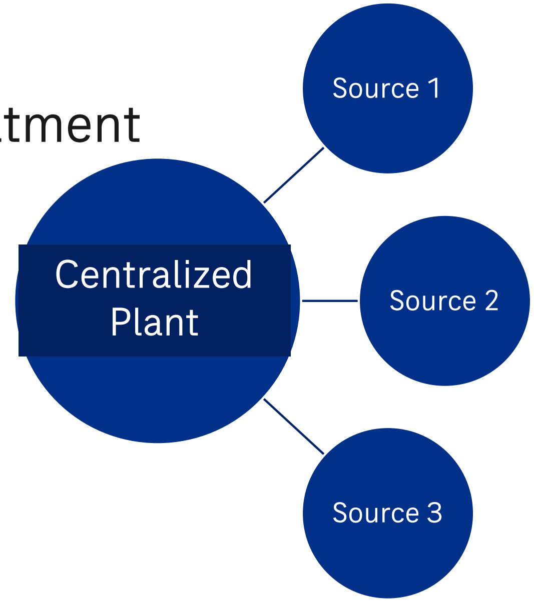


Graphic courtesy of Evoqua

PFAS Removal Strategies

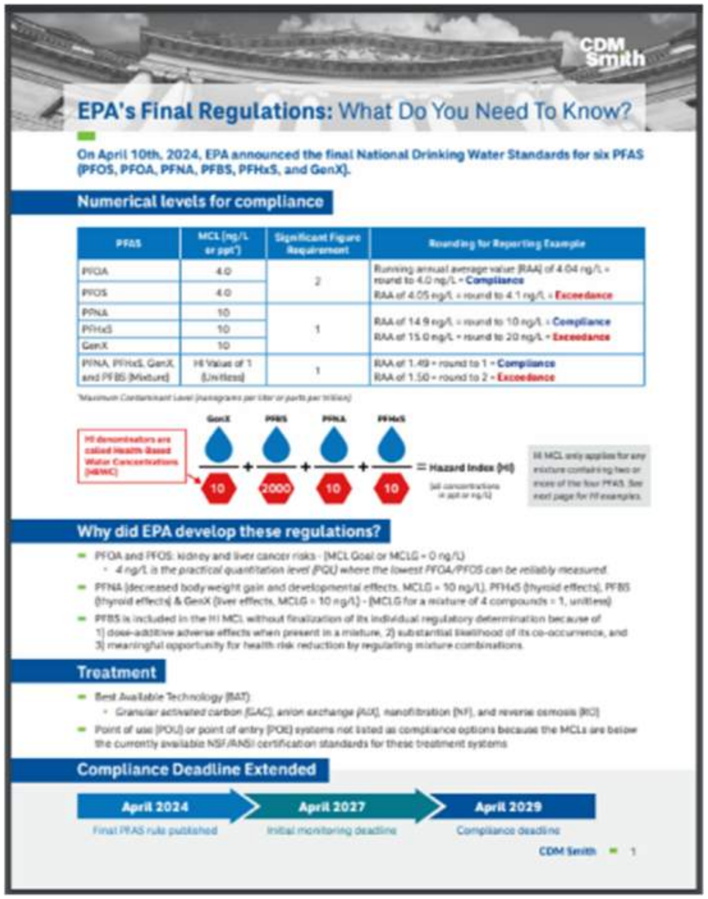
- Abandon Supply Source
- Find New Supply Source
- Blend with Source to Achieve Lower PFAS Concentration
- Treat PFAS at the Supply Source
- Combine Facilities to Centralize Treatment





Additional Resources

- Factsheet summary



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EPA's Final Regulations: What Do You Need To Know?

On April 10th, 2024, EPA announced the final National Drinking Water Standards for six PFAS (PFOS, PFOA, PFNA, PFBS, PFHxS, and GenX).

Numerical levels for compliance

PFAS	MCL (ng/L or ppt*)	Significant Figure Requirement	Rounding for Reporting Example
PFOA	4.0	2	Running annual average value (RAA) of 4.04 ng/L = round to 4.0 ng/L = **Compliance**; RAA of 4.05 ng/L = round to 4.1 ng/L = **Exceedance**
PFOS	4.0		
PFNA	10	1	RAA of 14.9 ng/L = round to 10 ng/L = **Compliance**; RAA of 15.0 ng/L = round to 20 ng/L = **Exceedance**
PFHxS	10		
GenX	10		
PFNA, PFHxS, GenX, and PFBS (Mixture)	HI Value of 1 (Unitless)	1	RAA of 1.49 = round to 1 = **Compliance**; RAA of 1.50 = round to 2 = **Exceedance**

Maximum Contaminant Level (nanograms per liter or parts per trillion)

HI denominators are called Health Based Water Concentrations (HBWC)

GenX / 10 + PFBS / 2000 + PFNA / 10 + PFHxS / 10 = Hazard Index (HI)

(all concentrations in ppt or ng/L)

HI MCL only applies for any mixture containing two or more of the four PFAS. See next page for HI examples.

Why did EPA develop these regulations?

- PFOA and PFOS: kidney and liver cancer risks - (MCL Goal or MCLG = 0 ng/L)
  - *4 ng/L is the practical quantitation level (PQL) where the lowest PFOA/PFOS can be reliably measured.*
- PFNA (decreased body weight gain and developmental effects, MCLG = 10 ng/L), PFHxS (thyroid effects), PFBS (thyroid effects) & GenX (liver effects, MCLG = 10 ng/L) - (MCLG for a mixture of 4 compounds = 1, unitless)
- PFBS is included in the HI MCL without finalization of its individual regulatory determination because of 1) dose-additive adverse effects when present in a mixture, 2) substantial likelihood of its co-occurrence, and 3) meaningful opportunity for health risk reduction by regulating mixture combinations.

Treatment

- Best Available Technology (BAT):
  - Granular activated carbon (GAC), anion exchange (AIX), nanofiltration (NF), and reverse osmosis (RO)
- Point of use (POU) or point of entry (POE) systems not listed as compliance options because the MCLs are below the currently available NSF/ANSI certification standards for these treatment systems

Compliance Deadline Extended

April 2024 — Final PFAS rule published
April 2027 — Initial monitoring deadline
April 2029 — Compliance deadline

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- AMWA webinar

Al LeBlanc, P.E., BCEE
Senior Vice President
Drinking Water Treatment Discipline Leader
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Connect with us!

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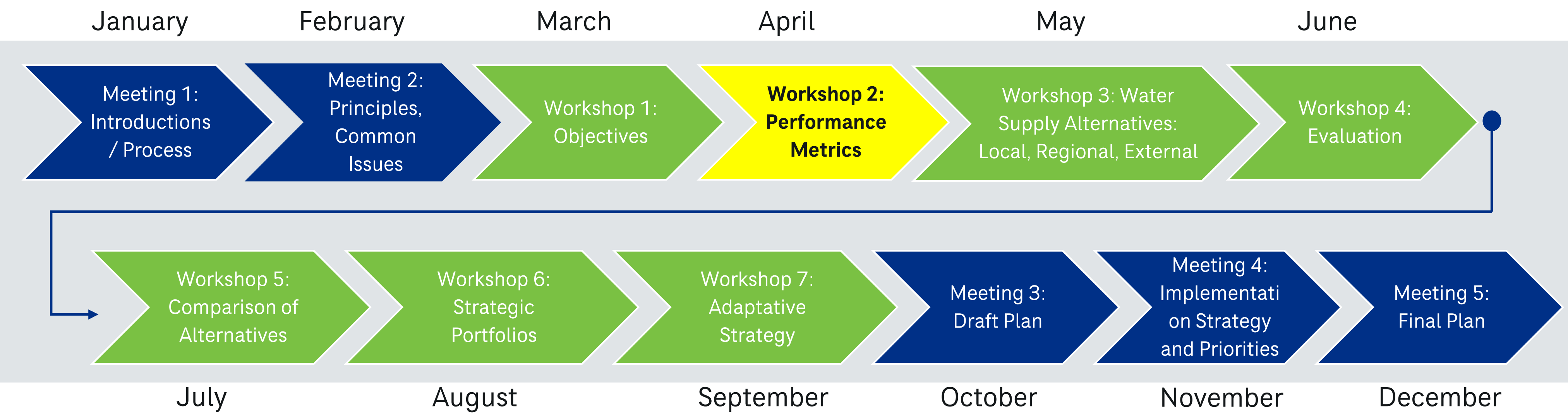
Review and Status of our Process

Overview of Regional Water Plan Process



Workshop Process

Workshop 1: Objectives

Workshop 2: Metrics

Workshop 3: Alternatives

Workshop 4: Evaluation

Workshop 5: Comparison

Workshop 6: Portfolios

Workshop 7: Adaptive Plan

Social, Environmental, Economic, Reliability, Other Goals

Quantitative and Qualitative Measurements of Progress toward Objectives (with Rubrics)

Local, Regional, and External Options for Water Supply and Resource Management

Review quantitative scores, collaborate on qualitative scoring, Individual weights for objectives

Distinguish most broadly beneficial, least beneficial, and discuss less clear alternatives

Group alternatives into strategic portfolios

Decision Tree: Short-Term Plan and Long-Term Options

Definitions of Terms for Strategic Planning

- **Guiding Principles**
  - Represent a set of core values that stakeholders use to guide the development of the plan, usually 3-5 statements that convey the following
- **Objectives**
  - Represent specific, measurable goals for the plan that are usually aligned to each guiding principle. There may be more than one objective for each guiding principle.
- **Criteria or Metrics**
  - The specific measurements of success in meeting the objectives.
- **Alternatives / Strategies**
  - The proposed actions or combinations of actions that will be evaluated against criteria/metrics.
- **Portfolios**
  - The groupings of alternatives that are considered for the final plan.

Our Objectives from Workshop 1 (March)

- Meet all current and future peak water demands **with climate resilient supply side and demand side strategies.**

- Meet safe drinking water quality regulations, current and future.

- Improve ecosystem health.

- Prioritize alternatives with high cost-benefit value.

- Promote equity by incorporating affordability, accessibility, and distribution of infrastructure impacts.

- Consider innovative and alternative solutions such as stormwater **capture**, wastewater **reuse** and water use efficiency.

- Encourage sustainable **potential for housing, economic development and prosperity.**

Our Objectives from Workshop 1 (March)

Original	Updates
• Meet all current and future peak water demands reflecting existing sources of water supply. • Meet safe drinking water quality regulations, current and future. • Improve ecosystem health. • Prioritize alternatives with high cost-benefit value. • Promote equity by incorporating affordability, accessibility, and distribution of infrastructure impacts. • Consider innovative and alternative solutions such as stormwater, wastewater and water use efficiency. • Encourage sustainable economic prosperity .	• Meet all current and future peak water demands **with climate resilient supply side and demand side strategies.** • Meet safe drinking water quality regulations, current and future. • Improve ecosystem health. • Prioritize alternatives with high cost-benefit value. • Promote equity by incorporating affordability, accessibility, and distribution of infrastructure impacts. • Consider innovative and alternative solutions such as stormwater **capture**, wastewater **reuse** and water use efficiency. • **Encourage sustainable potential for housing, economic development and prosperity.**

Metrics Example #1- Regional Plan in Florida

Objectives	Objective Weight	Metric
Deliver Utility System Reliability	30%	Supply shortages
Provide Cost-Effective Solutions	25%	Total levelized unit cost and total capital costs
Protect the Natural Environment	25%	Net aquifer withdrawal over planning period and total sustainable sources
Maximize Implementation	15%	Stakeholder acceptance, permitting ease and operational ease
Offer Community Benefits	5%	Leading edge solutions and co-benefits

Metrics Example #2 - Regional Plans in Austin, TX

Objective	Objective Weight	Criteria	Criteria Weight
Water Supply Benefits	25%	Maximize Resiliency	15%
		Increase Diversity of Sources	10%
Economic Benefits	25%	Provide Cost-Effective Services	15%
		Support Local/Regional Economy	10%
Environmental Benefits	20%	Reduce Impacts to Ecosystems	12%
		Meet GHG Emission Reductions	8%
Social Benefits	20%	Maximize Social Justice	10%
		Preserve Colorado River for All	10%
Implementation Ease	10%	Reflect Permitting/Legal Issues	10%

Examples Considering Units and Rubrics

Metric	Quantitative/Qualitative	Units
Maximize resiliency	Quantitative	% Reliability During Drought
Increase diversity of sources	Quantitative	# of Significant Sources
Provide cost-effective services	Quantitative	$/MG Delivered
Support local/regional economy	**Qualitative**	**Qualitative Rubric**
Meet GHG emission reductions	Quantitative	Carbon Loading in Pounds
Maximize social justice	**Qualitative**	**Qualitative Rubric**
Preserve Colorado River for all	Quantitative	% of documented needs met
Reflect permitting/legal issues	**Qualitative**	**Qualitative Rubric**

Example of a qualitative rubric on next slide

Examples of Qualitative Rubrics

Metric	1	2	3	4	5
Environmental Impacts	High Detrimental Impacts	Moderate Detrimental Impacts	Low Detrimental Impacts	No Detrimental Impacts	Environmental Benefits
Potential for Job Creation	May actually lose jobs	No clear opportunity	Potential for moderate job growth	Will definitely create some jobs	Will create many jobs
Supply Redundancy	No Redundancy	Potential for Future Redundancy	Isolated/ Partial Redundancy	Full Redundancy	--

"Better" should always be in the same direction

Guidelines for Qualitative Rubrics

- Be precise (try to avoid “poor-fair-good-better-best” if possible)
- Be confident that “bins” can be used to distinguish alternatives
- Only use as many as needed
- Carefully think about what is certain vs. what is only plausible

Break-Out Groups:
Proposed Metrics and Rubrics

A

Objectives

- Meet all current and future peak water demands with climate resilient supply side and demand side strategies.
- Improve ecosystem health.

People
Pine DuBois
John Haines
Bob Kostka
Kendra Martin
Val Massard
Liz Shea
Dan Sullivan
Kirk

B

Objectives

- Promote equity by incorporating affordability, accessibility, and distribution of infrastructure impacts.
- Meet current and future safe drinking water quality.

People
Jason Duff
Kimberly Groff
Shane O’Brien
Noreen O'Toole
Wayne Parks
Greg Swan
Brian Vasa
Amara

C

Objectives

- Consider innovative and alternative solutions such as stormwater capture, wastewater reuse, and water use efficiency.
- Prioritize alternatives with high cost-benefit value.

People
Jonathan Beder
Peter Gordon
Duane LaVangie
Phil McNulty
Greg Tansey
Bill and Grace

D (hybrid)

Objectives

- Encourage sustainable water use to meet the needs for housing and economic prosperity.

People
Peter Forman
Jon Hobill
Gavin Murphy
Jimmy Powell
Brian Vasa
Art Edgerton
Martin Pillsbury
Margherita Prior
Joanne and Kara

Coffee Break

Refinement of Metrics

Refinement of Metrics

- Group D:
  - Objective: Encourage sustainable water use to meet the needs for housing and economic prosperity
  - One metric for private well households: permitting for well re-digging. Track this on a regional scale to understand if there is no longer sustainable water supply
  - Another metric: additional water supply potential for economic development
    - May have limited data availability for this, would require measuring groundwater levels and surface water levels.
    - Ideas came up about how to incorporate recommendations for final water plan
    - Look at per capita water use- good indicator for if there is additional water
    - Unaccounted for water (UAW)- trends for this
    - Housing density efficiencies for water use – no specific metric mentioned
    - Conserved land that is left for water recharge
    - Public private partnerships
    - Peak demand may not be a good metric to understand “cushion” for economic development
    - High cost of water as a consideration for reclaimed water
    - Drought restrictions could be an indicator for some communities while others go under drought restrictions every year so would not be a useful

Refinement of Metrics

- Group C:
  - Consider innovative and alternative solutions such as stormwater capture, wastewater reuse and water use efficiency
    - Consensus that water use efficiency is the most useful
    - RGPCD is a measure of efficiencies
    - UAW is a measure of efficiency
    - Seasonal water use- to understand how much is being used for landscaping and nonessential uses
    - Cost of solutions
    - Ranking efficiency (efficiency = 4/5, traditional source (e.g. MWRA) = 2/3, wastewater reuse = 1)
    - Stormwater was considered as the least likely alternative- lowest on priorities

Refinement of Metrics

- Group C
  - High cost benefit value
    - Efficiency would be considered highest cost benefit value
    - Potential benefits from regional alternatives for high cost benefit value
    - Wastewater reuse isn’t cost effective
    - Potential metric $/ gallon in efficiency or $/gallon in water sourced, applied to different uses

Refinement of Metrics

- Group B
  - Promote equity by incorporating affordability, accessibility and distribution of infrastructure impacts
    - Equal access to goods= clean drinking water
    - Impacts of infrastructure don't impact more communities than others
    - Affordability- making sure that one community isn't paying significantly more than another community. But each community is it's own separate system
    - Potentially use something like Household Burden Index – evaluate the cost of water compared to income
    - Difference between regional and local equity- equity between communities versus within the same community
    - If there are going to be groups of projects that are going to benefit the region as a whole, where are those projects going to take place? Where

Refinement of Metrics

- Group B
  - Promote equity by incorporating affordability, accessibility and distribution of infrastructure impacts
    - Potential to assess comparing gaps between supply and demand- but difficult due to interconnections
    - Potentially look at RGPCD
    - Try to ensure federal and state government funding can be spread throughout the region
    - Consider the equity issue between private well owners and public water supply users

- Objective 2: Meet current and future drinking water quality
  - Scale (low) = not meeting required water quality standards, medium = meeting required drinking water quality standards, high = exceeding required water quality standards

Refinement of metrics

- Group A
  - Meet all current and future peak water demands with climate resilient supply side and demand side strategies
    - Only focusing on the end user of the water supply: delivering water as a percent of demand for the region
    - Resiliency within that supply on a regional scale- built in capacity – based on a specific goal to be determined- example of 20% buffer for climate resiliency
    - Objective 2: Improve ecosystem health
      - Groundwater levels
      - Streamflows
      - Connectivity of different water bodies
      - Fish migration patterns
      - We are probably below what we should be for a healthy ecosystem. Should use different parameters to have an ecosystem index. Track over time, and have metrics based off of positive trend on ecosystem index. May be able to use MA state data related to this, or set for our own region

Annotated Bibliography

Annotated Bibliography

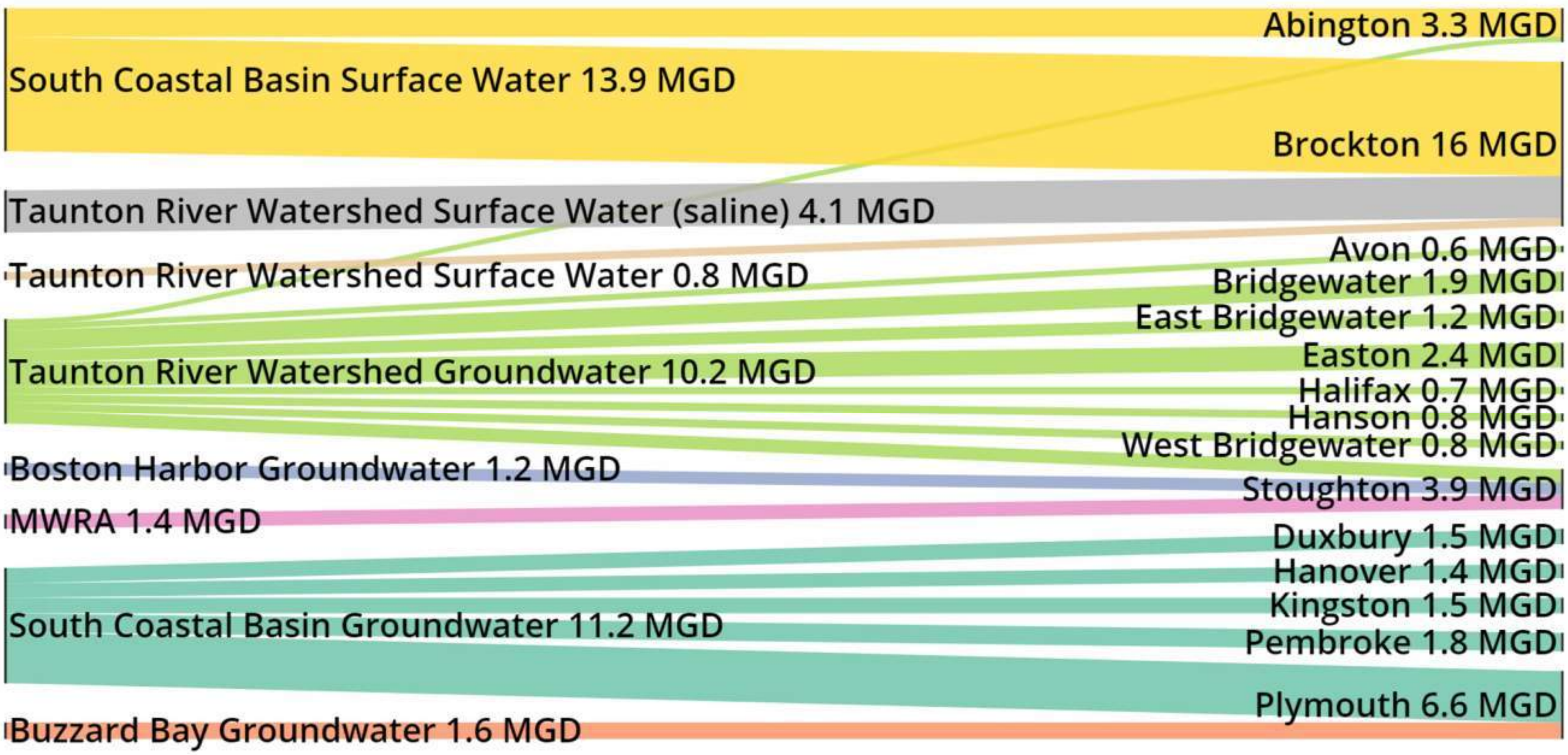
- Each community had a question section, which we are hoping to hear back about

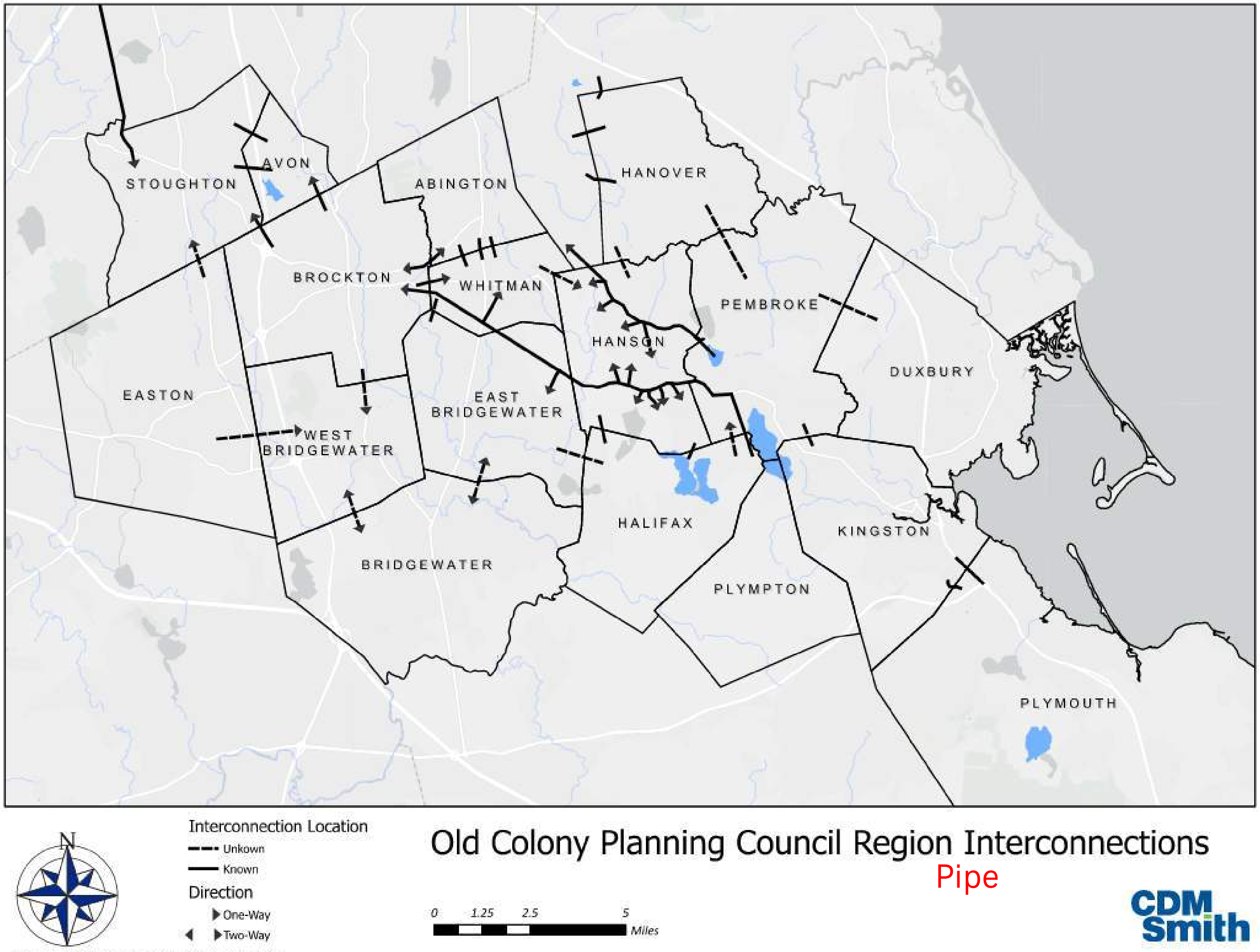
- By May 1st:
  - Review the relevant section
  - Send us any edits or updated documents
  - Answer our questions in the last subsection

Regional Schematic

Sankey Diagram- Water Management Act Permitted Amounts

Water Source – Total Amount Allotted to the Region





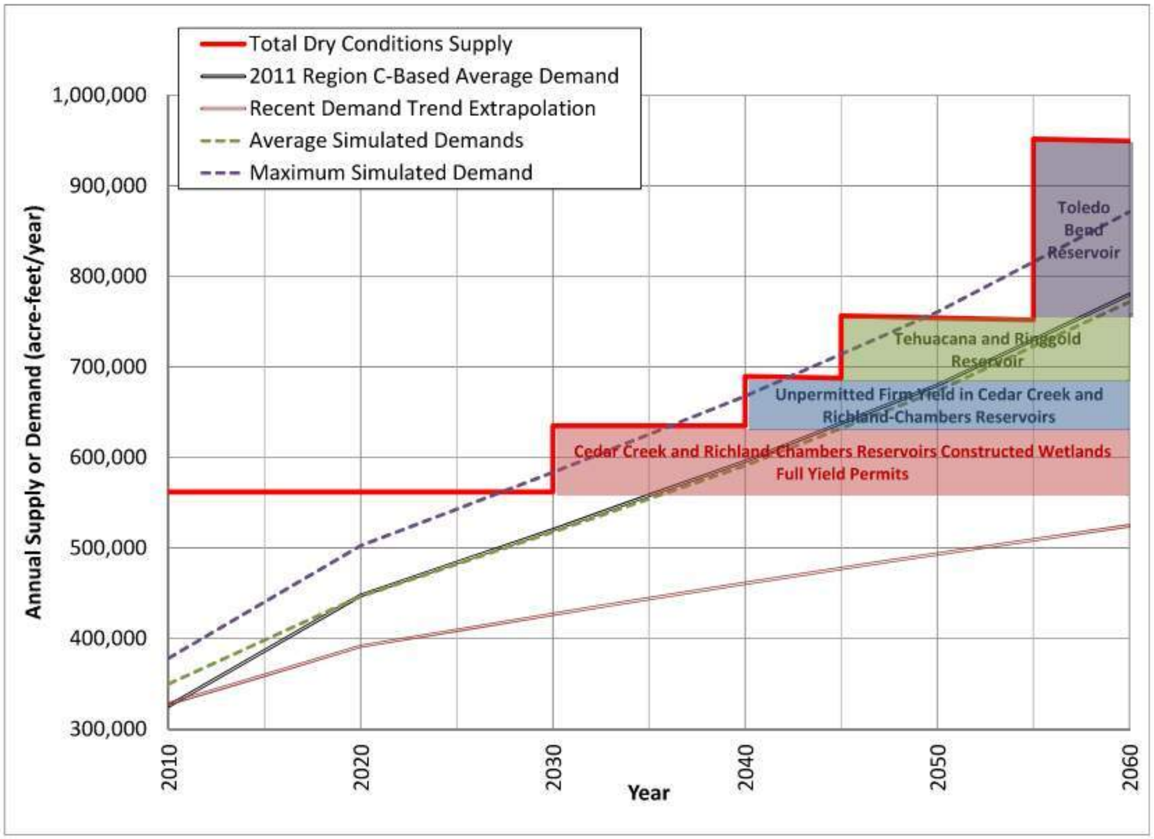
Old Colony Planning Council Region Interconnections

Pipe

CDM Smith

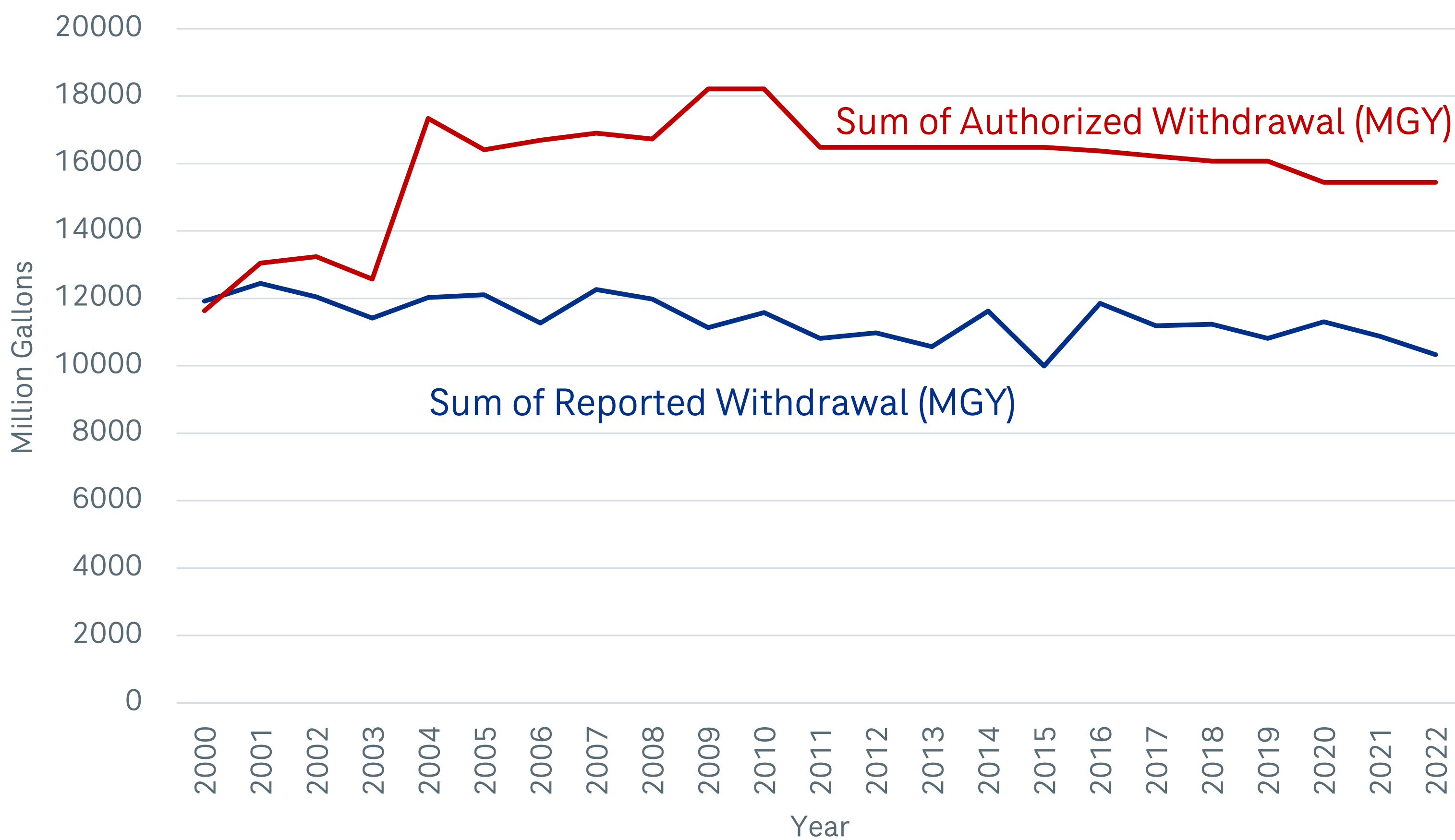
Demand Projections

Texas Demand Gap Analysis Example



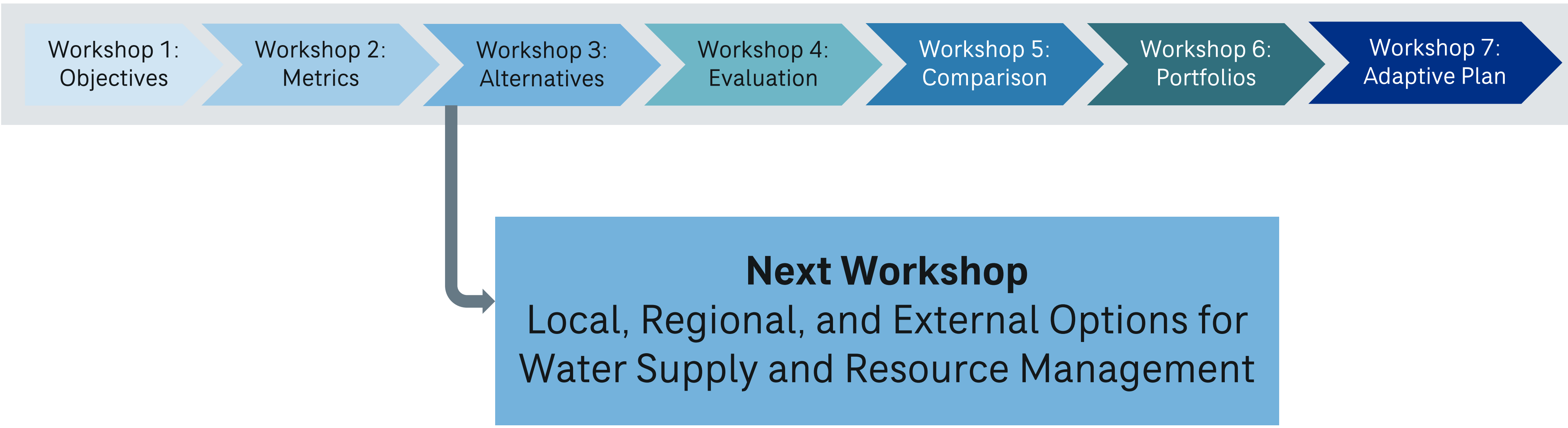
Tarrant Regional Water District, 2013 Integrated Water Supply Plan, Figure 4.28.

Historic Withdrawals for the Region Shown with WMA Authorized Withdrawals



Next Workshop

Workshop Process



Upcoming Schedule

WHEN	DETAILS
Monday, May 20th 9:00 am – 12:00 pm	Workshop 3
Tuesday, June 25th 9:00 am – 12:00 pm	Workshop 4
Wednesday July 31st 9:00 am – 12:00 pm	Workshop 5
Tuesday, August 27th 9:00 am – 12:00 pm	Workshop 6
Tuesday, September 24th 9:00 am – 12:00 pm	Workshop 7
Tuesday, October 29th 9:00 am – 12:00 pm	Meeting 3
Monday, November 18th 8:00 am – 12:00 pm	Meeting 4
Tuesday, December 10th 8:00 am – 12:00 pm	Meeting 5

Feedback Survey

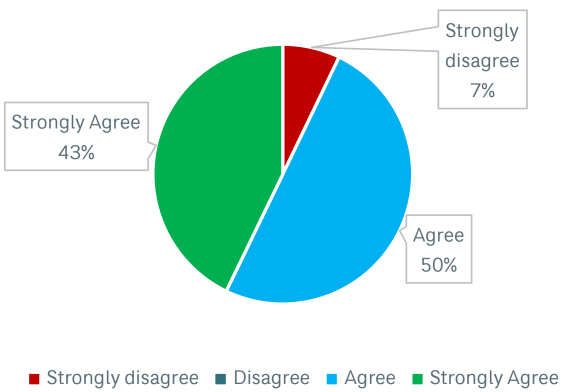
Last Meeting: Feedback Survey Results

1. Please tick one box per row.
The meeting had a clear agenda.
Facilitation of today's meeting was effective.
I had plenty of opportunity to participate in the discussion today.
Interactions were positive and respectful.
I understand where we are in the process and where we are going.

Strongly disagree	Disagree	Agree	Strongly agree

Last Meeting: Feedback Survey Results

The meeting had a clear agenda.



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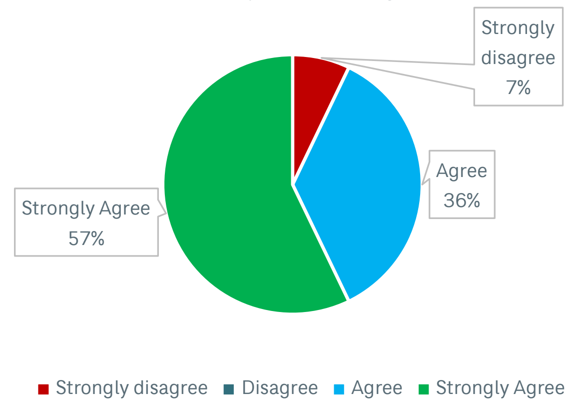
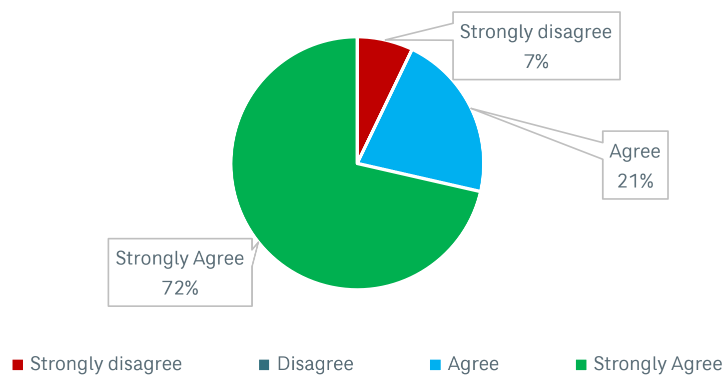


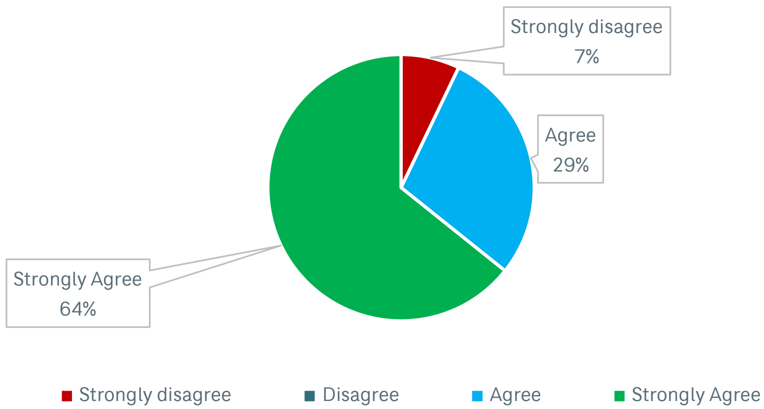
Legend
- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

I had plenty of opportunity to participate in the discussion today.



Last Meeting: Feedback Survey Results

Interactions were positive and respectful.



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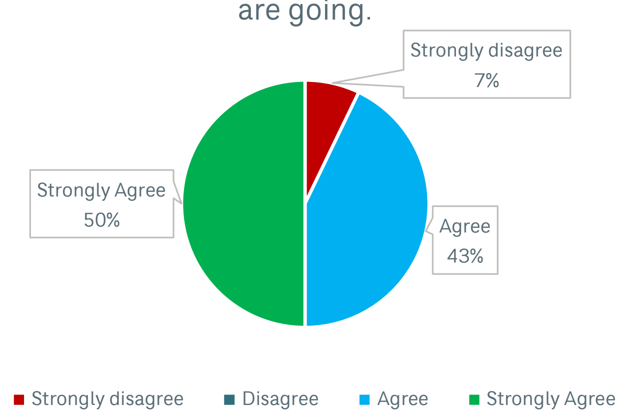


Legend
- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Appendix F
Steering Committee Workshop 3
05-20-2024

OLD COLONY PLANNING COUNCIL

Rebecca Coletta, President | Mary Waldron, Executive Director

(508) 583-1833 | 70 School Street, Brockton, MA 02301 | www.oldcolonyplanning.org

Regional Water Plan
Steering Committee Meeting
MINUTES OF THE MEETING
Monday, May 20, 2024, 9:00am

Location: Old Colony Planning Council, 70 School St, Brockton, MA 02301

Attendees:

Steering Committee	
Organization	**Name**
Town of Abington	Liz Shea
Town of Bridgewater	Shane O'Brien
Town of Bridgewater	Greg Tansey
City of Brockton	Pat Hill
CPCWDC	Kimberly Groff (via Zoom)
East Bridgewater	John Haines
Easton Department of Public Works	Greg Swan
EPA	Margherita Pryor (via Zoom)
Town of Kingston	Val Massard
MA Department of Conservation and Recreation	Jason Duff (via Zoom)
MAPC	Martin Pillsbury (via Zoom)
MassDEP	Duane LeVangie
MassDEP	Jon Hobill (via Zoom)
Pembroke Water Department	Dan Sullivan
OCPC	Joanne Zygmunt
Town of Plymouth	Peter Gordon
Town of Plympton	Brian Vasa
Town of Stoughton	Phil McNulty
Watershed Associations	Pine duBois
Watershed Associations	Jimmy Powell (via Zoom)
Town of West Bridgewater	Wayne Parks

Observers	
Organization	**Name**
SRPEDD	Danica Belknap (via Zoom)
OCPC	Becky Coletta (via Zoom)
OCPC	Bill Napolitano (via Zoom)
Cape Cod Cranberry Growers' Association	Brian Wick

Consultants	
Organization	**Name**
CDM Smith	Grace Houghton (via Zoom)
CDM Smith	Kirk Westphal
CDM Smith	Amara Regehr
CDM Smith	Grace Inman
CDM Smith	Kara Rozycki
Regina Villa Associates	Kyle Olsen (via Zoom)
Alliance for Water Efficiency	Andrew Morris

Minutes:

1. Call to Order, introductions
    a. New attendees: Brian Wick (Cape Cod Cranberry Growers' Association), Andrew Morris (Consultant, Alliance for Water Efficiency), Grace Houghton (Consultant, CDM Smith), Brian Shepherd (Consultant, CDM Smith)
2. Public Comment – none
3. Technical Work
    a. Public Outreach ongoing. Interviews being conducted by RVA. Reminders coming from Kyle Olsen of RVA to town officials and steering committee members.
    b. Annotated Bibliography Draft complete, team completing updates
    c. Water availability models for Taunton and South Coastal Watersheds ongoing
    d. Demand analysis ongoing
    e. Water efficiency ongoing
    f. Future climate conditions upcoming
    g. Alternatives upcoming
4. Definitions
    a. Discussion of EJ vs. EJ population
5. Metrics Finalization

a. Request to remove “local needs” from “supply volume beyond local needs”

b. Request to define “gap” as a unit

c. Request to remove “or” from “quantity and quality of natural waters”

d. Request to define quantity using DEP sub-basin quantity

e. net export of water from its original aquifer

f. Incorporate undocumented immigrant populations and major prisons into equity metrics.

g. MetroWest Climate Equity Project includes equity information (Shane to distribute)

h. Newspaper article over the weekend includes MBTA proposed projects

i. Metrics and updates to be distributed to group via email

j. Fisheries information available

6. Alliance for Water Efficiency

   a. Presentation provided by Andrew Morris from Alliance for Water Efficiency

   b. Discussion:

      i. DEP requires AWWA M36 model if UAW 10% is not met. Grants are available in August.

      ii. Discussion of water bans and charging more for irrigation, which would require an irrigation meter.

      iii. Discussion of multi-family units.

      iv. Conservation rate structure grant from DEP also available in August.

      v. Breakout groups on efficiency

      vi. Feasibility of public/leadership/political acceptance to be considered as a metric

7. Introduction to Demand Projections

   a. Presentation provided by Brian Shepard from CDM Smith introducing how demand is calculated.

   b. To be continued at next workshop, along with alternatives introductions.

8. Next Workshop

   a. 6/25/2024

Action Items:

Assigned to	Action Item
Steering Committee members	Review annotated bibliographies and respond to interview requests
CDM Smith	Update metrics and distribute to steering committee

Attachments:

1. Meeting Presentation Slides

Prepared by CDM Smith.

Old Colony Planning Council Regional Water Plan

Workshop 3

Economic Resilience and Sustainable Water Supply

Kirk Westphal, Kara Rozycki, Tarun Gill,
Andrew Morris, Brian Shepard,
and Amara Regehr

May 20, 2024

Central Plymouth County Water District Commission

SOUTH SHORE CHAMBER OF COMMERCE

CDM Smith

1

Agenda

1. Public Comment
2. Overview of Technical Work
3. Definitions
4. Metrics Finalization Discussion

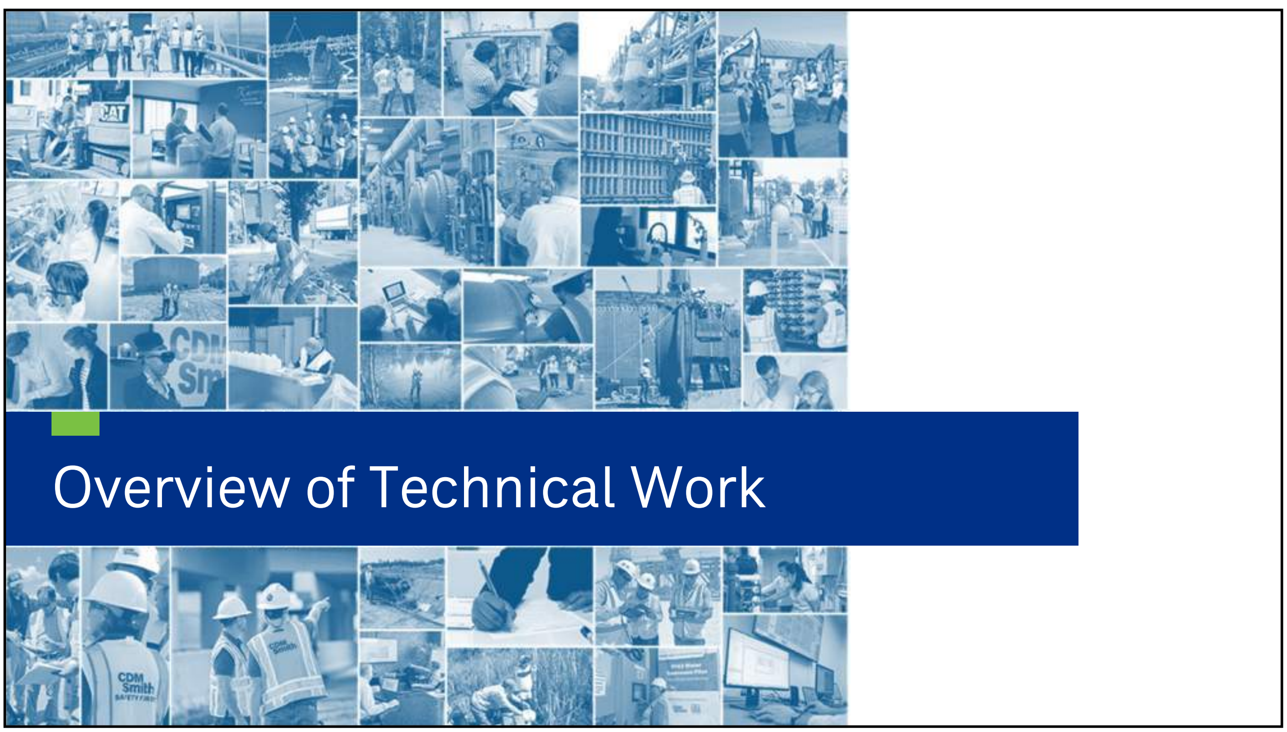
   Coffee Break

5. Water Efficiency
6. Alternatives Introduction
7. Demand Projections Introduction
8. Next Workshop

OCPC Regional Water Plan 2

2

3



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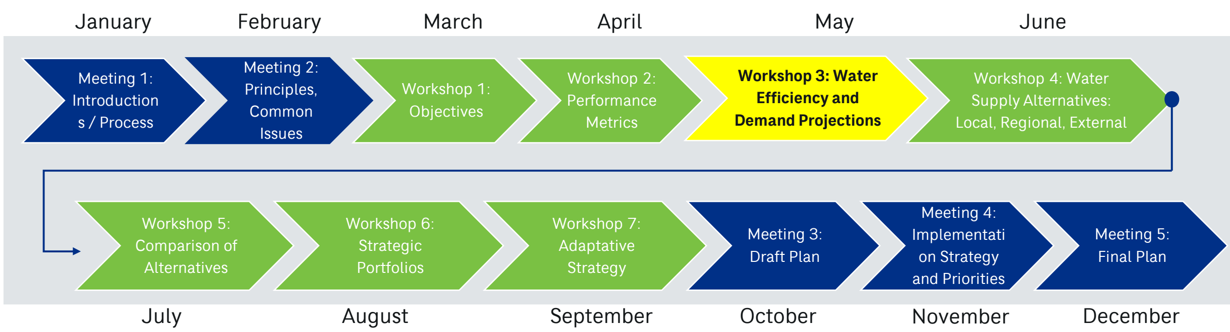
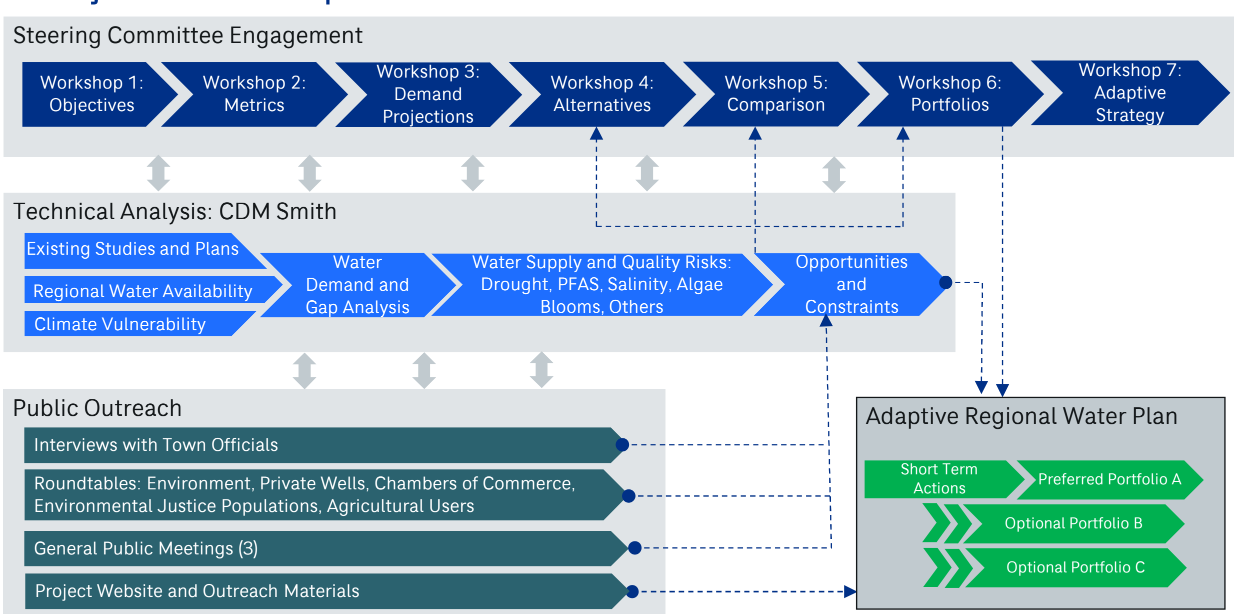
Overview of Regional Water Plan Process



5

Project Roadmap



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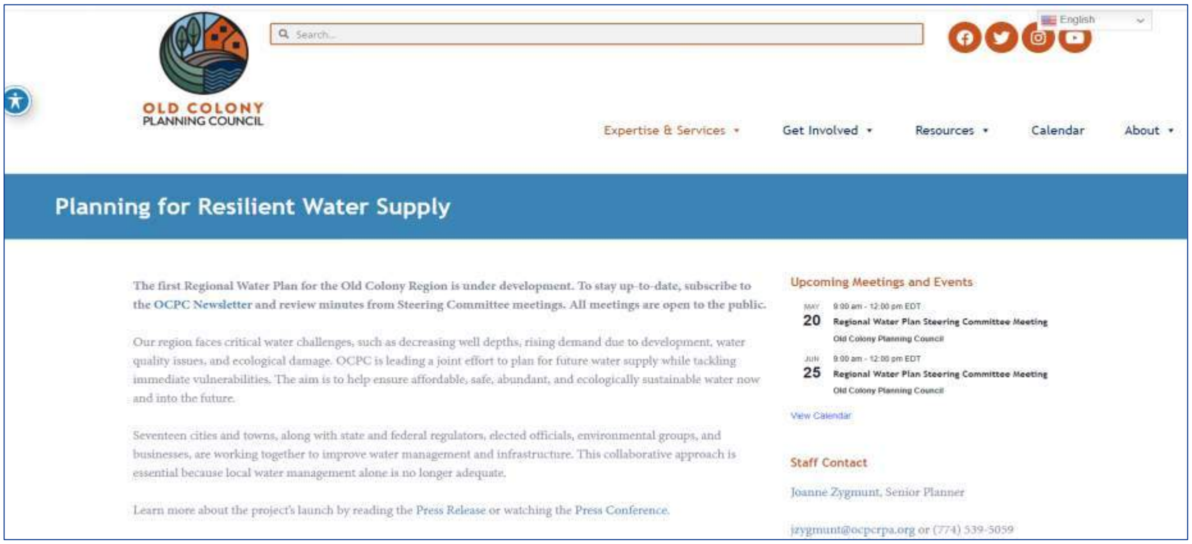
Project Website



https://oldcolonyplanning.org/waterplan/

OCPC Regional Water Plan 7

7

Technical Work

Technical Analysis: CDM Smith

- Existing Studies and Plans
- Regional Water Availability
- Climate Vulnerability

→ Water Demand and Gap Analysis → Water Supply and Quality Risks: Drought, PFAS, Salinity, Algae Blooms, Others → Opportunities and Constraints

- Annotated Bibliography Draft (complete)
  - Updates from communities (ongoing)
- Water availability models for Taunton and South Coastal Watersheds
  - Accounts for both surface and groundwater availability based on USGS data
  - Can be used to model future climate conditions based off projections for temperature and precipitation

OCPC Regional Water Plan 8

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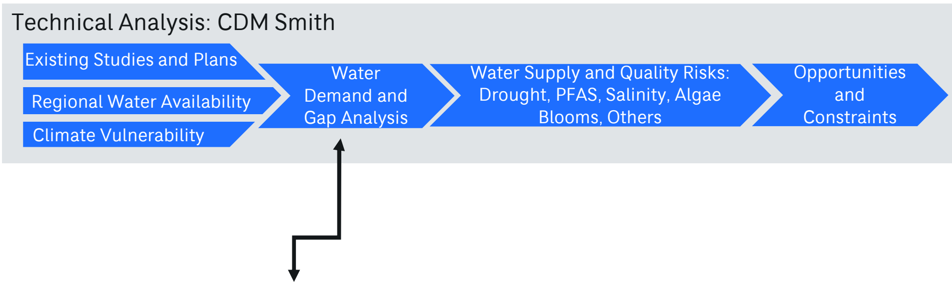
Technical Work

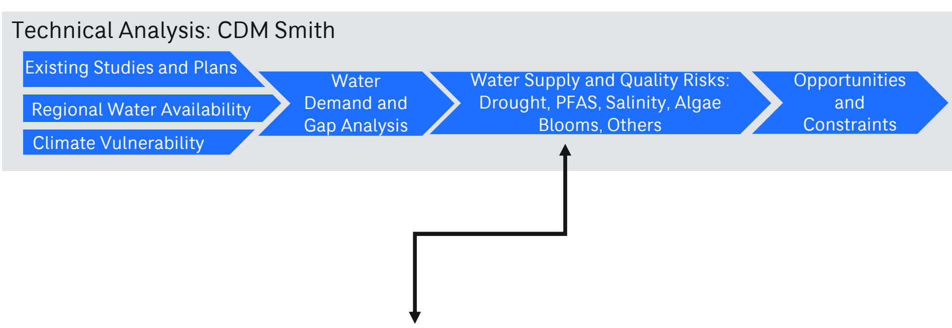


Discuss Today

- Introduction to the demand analysis conducted by CDM Smith
- Water efficiency by Alliance for Water Efficiency

9

Technical Work



Upcoming technical work

- Work with Professor Casey Brown of UMass Amherst to understand future climate conditions and impacts to water quality and water quantity

10

Technical Work

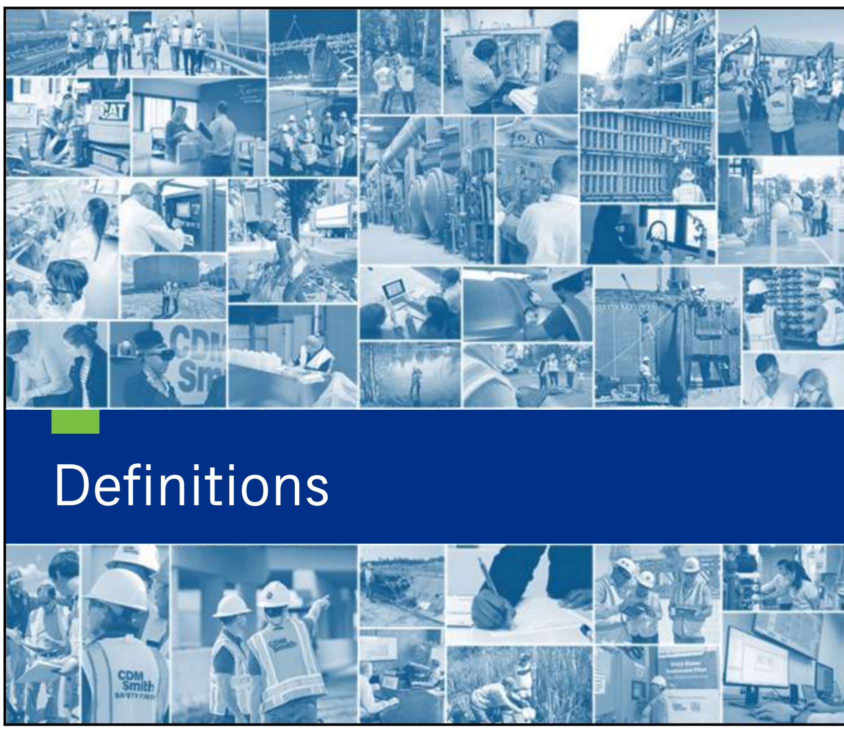
Technical Analysis: CDM Smith

- Existing Studies and Plans
- Regional Water Availability
- Climate Vulnerability

→ Water Demand and Gap Analysis → Water Supply and Quality Risks: Drought, PFAS, Salinity, Algae Blooms, Others → Opportunities and Constraints

Ongoing: CDM Smith to support the development of alternatives with creation of figures, high level costs, and other pieces to support future implementation

11



Definitions

12

Definitions of Terms for Strategic Planning

Engagement Protocols	Guiding Principles
Objectives	Criteria / Metrics
Alternatives/ Strategies	Portfolios

13

Terms used in our Guiding Principles

- Recommend sustainable water supply strategies that balance social, environmental, and economic needs for the region.
- Align with values of good stewardship and wise use of water.
- Reflect the limits of our natural resources and current/anticipated regulations.
- Incorporate uncertainties so implementation of recommendations can adapt over time.
- Strive for **environmental justice and** equity ~~and social justice~~ within and among the communities.
- Produce a list of "early-win" projects that can be aligned with available outside funding.

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Terms used in our Objectives

- Meet all current and future peak water demands with climate resilient supply side and demand side strategies.
- Meet safe drinking water quality regulations, current and future.
- Improve ecosystem health.
- Prioritize alternatives with high cost-benefit value.
- Promote environmental justice and equity **between communities** ~~by incorporating affordability, accessibility, and distribution of infrastructure impacts.~~
- Consider innovative and alternative solutions such as stormwater capture, wastewater reuse and water use efficiency.
- Encourage sustainable potential for housing, economic development and prosperity.

15

Definitions of Highlighted Terms

Highlighted Term	Definition	Source
Sustainability	In practice, sustainability refers to efforts to align economic development with environmental protection and human well-being. Sustainability is commonly characterized in terms of the interdependence among three broad dimensions—environment, economy, and society—while considering both present and future generations.	United States EPA
Equity	Equity is defined as being fair and impartial, and providing what each group needs so they can experience fair and equitable treatment.	Massachusetts Office of Diversity and Equal Opportunity
Environmental Justice	Based on the principle that all people have a right to be protected from environmental hazards and to live in and enjoy a clean and healthful environment regardless of race, color, national origin, income, or English language proficiency. Environmental justice is the equal protection and meaningful involvement of all people and communities with respect to the development, implementation, and enforcement of energy, climate change, and environmental laws, regulations, and policies and the equitable distribution of energy and environmental benefits and burdens.	Massachusetts Municipal Vulnerability Preparedness (MVP) Program

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Definitions of Highlighted Terms

Highlighted Term	Definition	Source
Climate Resilience	The ability of a community to address the needs of its built, social, and natural environment in order to anticipate, cope with, and rebound stronger from events and trends related to climate change hazards, including temperature changes, extreme weather, sea level rise, coastal and inland flooding, changes in precipitation, and other impacts.	Massachusetts MVP Program

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Metrics Finalization Discussion

18

A

Objectives

- Meet all current and future peak water demands with climate resilient supply side and demand side strategies.
- Improve ecosystem health.

People
Pine DuBois
John Haines
Bob Kostka
Kendra Martin
Val Massard
Liz Shea
Dan Sullivan
Kirk

B

Objectives

- Promote equity by incorporating affordability, accessibility, and distribution of infrastructure impacts.
- Meet current and future safe drinking water quality.

People
Jason Duff
Kimberly Groff
Shane O'Brien
Noreen O'Toole
Wayne Parks
Greg Swan
Brian Vasa
Amara

C

Objectives

- Consider innovative and alternative solutions such as stormwater capture, wastewater reuse, and water use efficiency.
- Prioritize alternatives with high cost-benefit value.

People
Jonathan Beder
Peter Gordon
Duane LaVangie
Phil McNulty
Greg Tansey
Bill and Grace

D (hybrid)

Objectives

- Encourage sustainable water use to meet the needs for housing and economic prosperity.

People
Peter Forman
Jon Hobill
Gavin Murphy
Jimmy Powell
Brian Vasa
Art Edgerton
Martin Pillsbury
Margherita Prior
Joanne and Kara

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Metrics Finalization

- CDM Smith used input from the April steering committee meeting to develop meaningful metrics for this region
- The steering committee will review the draft metrics today
- The steering committee can revisit these metrics prior to their application later in July/August as needed

OCPC Regional Water Plan 20

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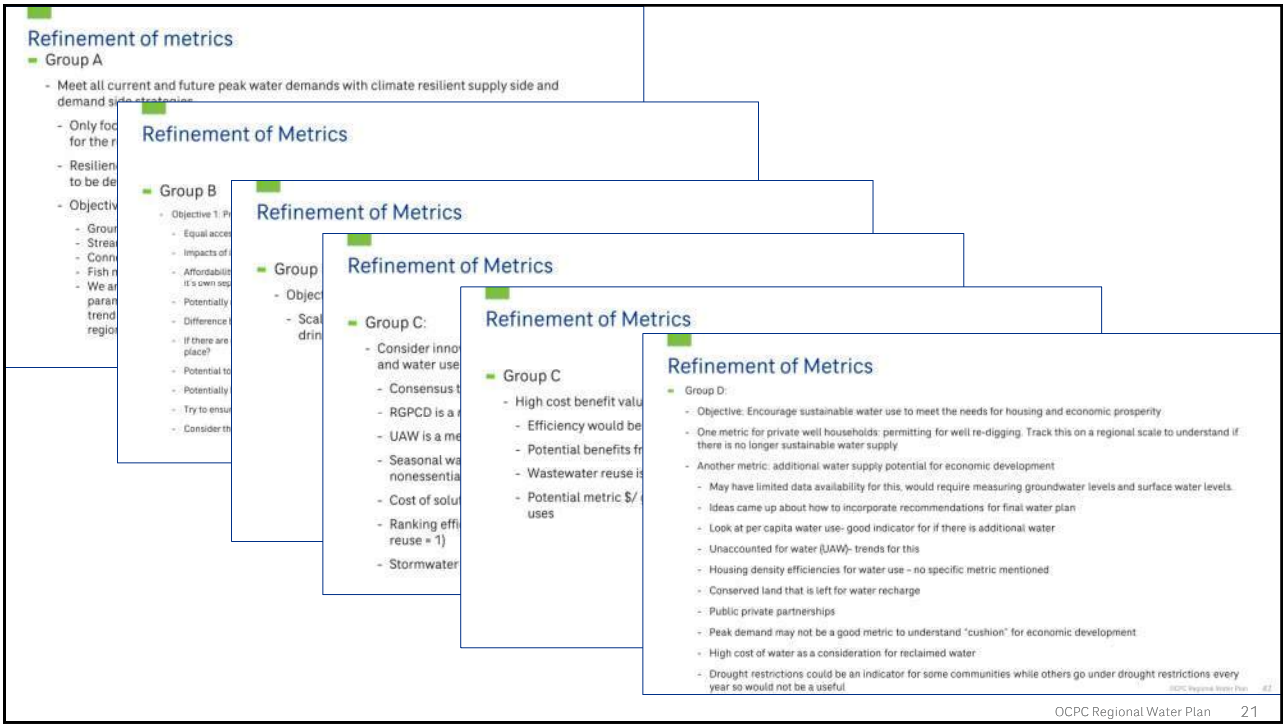

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Decision Framework

Objective	Metric	Units (or qualitative)
Meet all current and future peak water demands with climate resilient supply side and demand side strategies	Amount of regional supply gap filled (seasonal peak)	% of gap
	Supply volume beyond local needs	% of gap
Improve ecosystem health	Connectivity of natural waters	Qualitative
	Quantity and/or quality of natural waters	Qualitative
High Benefit: Cost value	Volume of supply gap reduced per unit cost	MG/$M
Consider innovative and alternative solutions such as stormwater capture, wastewater reuse and water use efficiency	Water supply- volume of supply that is considered innovative	MG
	Water efficiency- volume of demand decreased	MG
Promote environmental justice and equity between communities	Percent of MA designated EJ census tracts served by alternative	% of census tracts
	Percent of MA designated EJ census tracts not impacted by construction	% of census tracts
Meet current and future drinking water quality standards	Total supply vulnerable to salinity/PFAS, etc.	% of total new supply
Encourage sustainable water use to meet the needs for housing and economic prosperity	Flexibility in phasing and supply capacity	Qualitative

More info on following slides

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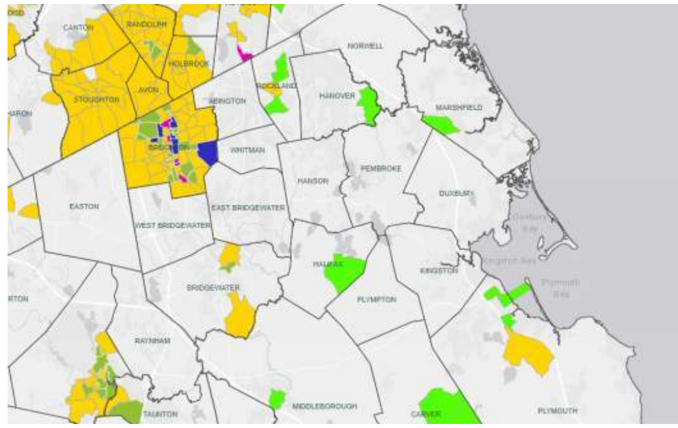
Objective: Promote environmental justice and equity between communities

- Before we get into qualitative scales, lets look briefly at the state's data source that will be used for evaluating this metric



https://mass-eoeea.maps.arcgis.com/apps/webappviewer/index.html?id=1d6f63e7762a48e5930de84ed4849212

23

Objective: Improve ecosystem health

Objective	Metric	Units (or qualitative)	Qualitative Scales				
			1	2	3	4	5
Improve ecosystem health	Connectivity of natural waters	Qualitative	Major detrimental impact to connectivity	Minor detrimental impact to connectivity	Neutral impact to connectivity	Minor positive impact to connectivity	Major positive impact to connectivity
	Quantity and/or quality of natural waters	Qualitative	Major detrimental impact to quantity and/or quality	Minor detrimental impact to quantity and/or quality	Neutral impact to quantity and/or quality	Minor positive impact to quantity and/or quality	Major positive impact to quantity and/or quality

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Objective: Encourage sustainable water use to meet the needs for housing and economic prosperity

Objective	Metric	Units (or qualitative)	Qualitative Scales		
			1	2	3
Encourage sustainable water use to meet the needs for housing and economic prosperity	Flexibility in phasing and supply capacity	Qualitative	Low flexibility in time or volume	High flexibility in time or volume	Fully able to meet anticipated future needs

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Future updates to metrics

- Opportunities to update metrics later in the process
- We will be conducting roundtable discussions with:
  - Private well users
  - Environmental groups
  - Chambers of commerce
  - Environmental justice communities
  - Cranberry growers

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Coffee Break

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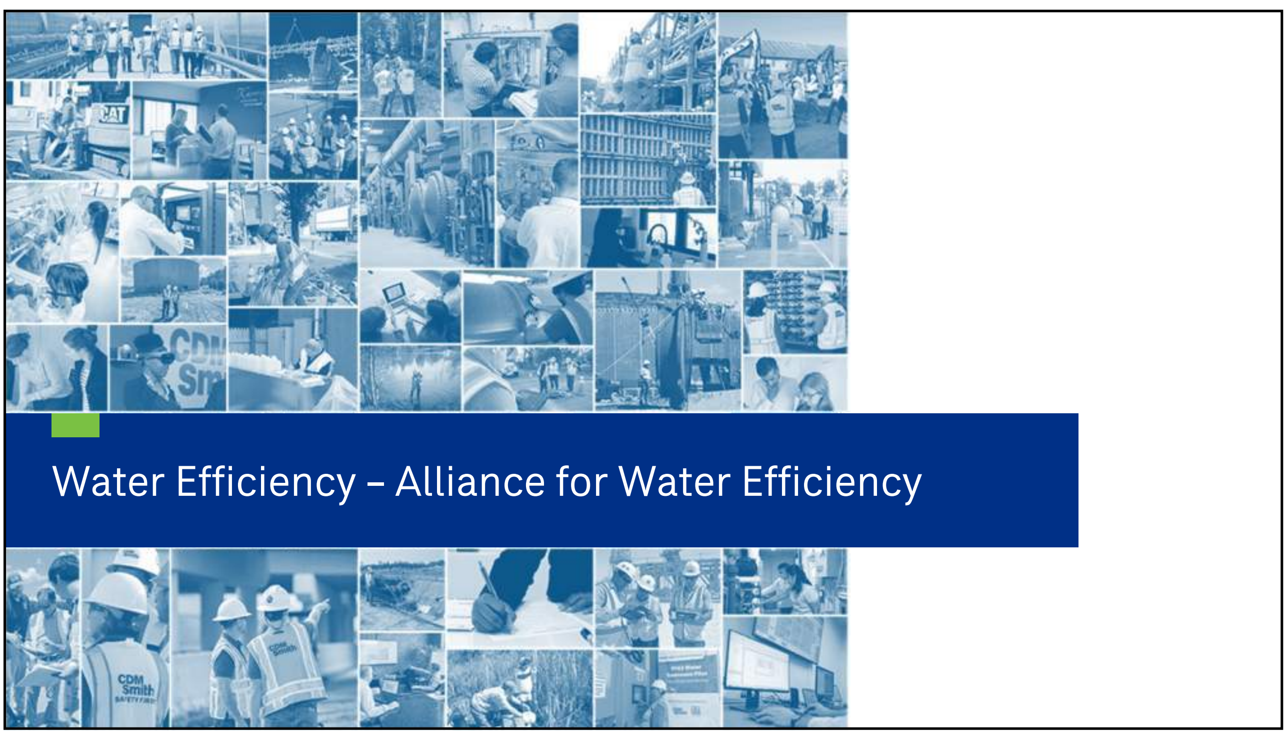
Water Efficiency – Alliance for Water Efficiency

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Alliance for Water Efficiency

The Alliance for Water Efficiency is a stakeholder-based nonprofit organization dedicated to the efficient and sustainable use of water.

Collaboration: Network of colleagues across water providers, governments, business and industry, researchers, nonprofits and other partners.

Knowledge: Creating and sharing resources, tools, trainings, expertise and research.

Change: Advocacy for funding, policies, and partnerships that advance water efficiency.

Learn more: www.a4we.org

Alliance *for* Water Efficiency

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About The Process

Process for developing preliminary recommendations:

1. Reviewed the annotated bibliography CDM prepared
2. Reviewed water data from OCPC communities
3. Reviewed state laws, plans, and standards
4. Reviewed water rates and structures from OCPC communities
5. Reviewed several OCPC regional plans
6. Compared regional efforts to other regions in the Eastern U.S. and beyond
7. Compared regional efforts to American Water Works Association G480-20 Standard for Water Conservation and Efficiency Program Operation and Management

My Background: 15 years experience working for utilities on law, policy, and planning. Major focus areas include developing supplies and implementing demand-side alternatives. Experience in the private, public, and nonprofit sectors. Certified utility water loss validator and trainer in Georgia, one of the two leading states for water loss. Education: JD from University of Notre Dame; BA from the University of Georgia.

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Let's Start with an Icebreaker

When I say water efficiency, what words come to mind?

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Focus for Today – Water efficiency recommendations for long-term demand reductions

Broader Analysis to Come – Written report that will also cover:
1. Advanced approaches to water efficiency
2. Drought planning and response
3. Efficiency and Affordability
4. Public Education
5. Passive Water Efficiency: State and Federal Codes and Standards

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Water Efficiency and Conservation:
Important Even When Water is Abundant
Alliance for Water Efficiency
Water efficiency and conservation are typically the fastest and least expensive ways to help ensure that communities and agriculture have access to affordable, sustainable water supplies. Climate change is fueling hotter, dryer weather, and nearly every state experienced drought in 2022, which was the worst drought in hundreds of years in the Western U.S.
However, water efficiency and conservation offer multiple sustainability benefits beyond keeping the water running, just as energy efficiency does more than keep the lights on. It's time to de-bunk the common misperception that water efficiency and conservation are only important in arid regions or when drought sets in.
A brief overview of water efficiency and conservation's other benefits:
Mitigating climate change by reducing energy use and greenhouse gas emissions associated with heating, pumping, and treating water/ wastewater.
Adapting to climate change by making communities more resilient to drought and heavy rain events.
Reducing costs for businesses and supporting corporate sustainability goals.
Making more water available to support healthy stream flows and lake levels for plants and animals.
Reducing the need to build or expand expensive drinking water and wastewater systems.
Limiting nutrient runoff associated with landscape and agriculture.
Helping communities manage water shortages related to water quality problems.
Using technologies that detect leaks to save water and help prevent property damage.
Making water bills more affordable.
Minimizing land subsidence linked to excess groundwater withdrawals.
ALLIANCEFORWATEREFFICIENCY.ORG CHICAGO, IL 773.360.5100 INFO@A4WE.ORG
WIN WIN

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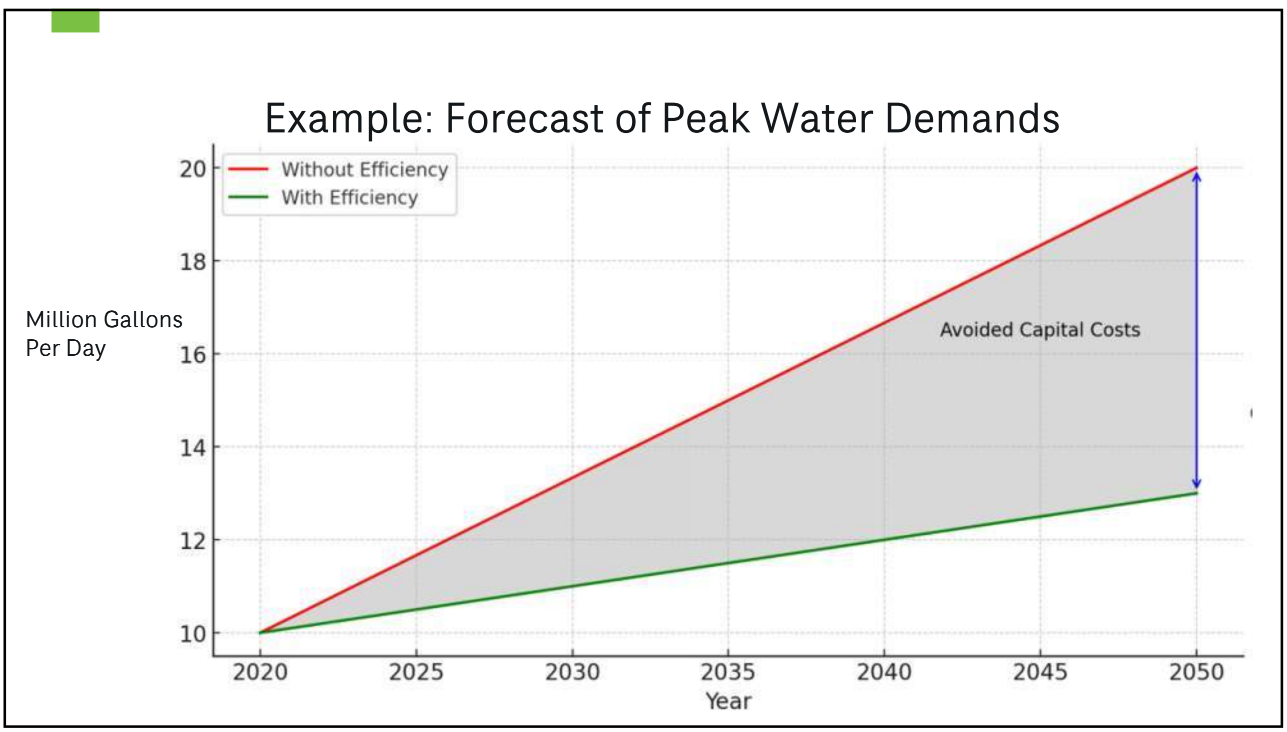
Example: Forecast of Peak Water Demands
Without Efficiency
With Efficiency
Million Gallons Per Day
20
18
16
14
12
10
Avoided Capital Costs
2020
2025
2030
2035
2040
2045
2050
Year

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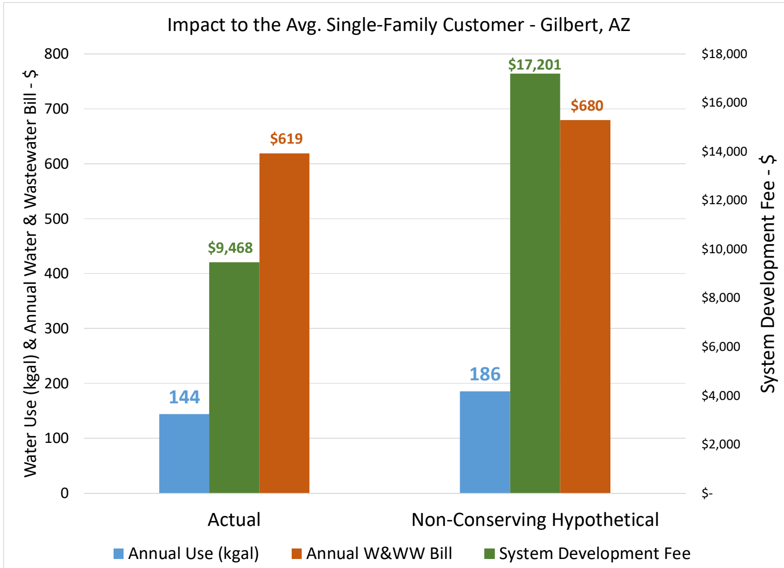
Example AWE Report: Conservation Minimizes Rate Increases for an Arizona Utility



www.allianceforwaterefficiency.org/resources/financing-sustainable-water

35

Preliminary recommendations for long-term demand reductions

1. Conduct, Validate, and Act on Annual American Water Works Association (AWWA) Water Loss Audits
2. Adopt Advanced Metering Infrastructure and Monthly Billing
3. Implement Customer-Side Leak Detection Programs
4. Improve Increasing Block Rate Designs

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Preliminary Recommendation #1:

Conduct, Validate, and act on AWWA Water loss audits

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Unaccounted for water Methodology in Massachusetts

Water Treated *minus*
Metered Water Use *minus*
<u>Confidential Estimated Municipal Use</u> =
Unaccounted For Water

Unaccounted for water includes, among other things, physical leak in the water utility's distribution system; **reducing leaks is an alternative to increasing supplies**

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Confidently Estimated Municipal Use (CEMU)		Estimated million gallons per year
Fire protection & training		0.25
Hydrant/water main flushing/main construction	+	4.15
Flow testing	+	0.1
Bleeders/ Blow offs	+	0
Tank overflow & drainage	+	2.5
Sewer & stormwater system flushing	+	0.02
Street cleaning	+	0.05
Source meter calibration adjustments	+	0
Major water main breaks (not leak detection)	+	0.5
Total Confidently Estimated Municipal Use	=	7.57

ReCalculate Total

YOU MUST PROVIDE DOCUMENTATION FOR ALL OF YOUR CEMU VOLUMES.

Source: Massachusetts Department of Environmental Protection Drinking Water Program Instructions for the Annual Statistical Report

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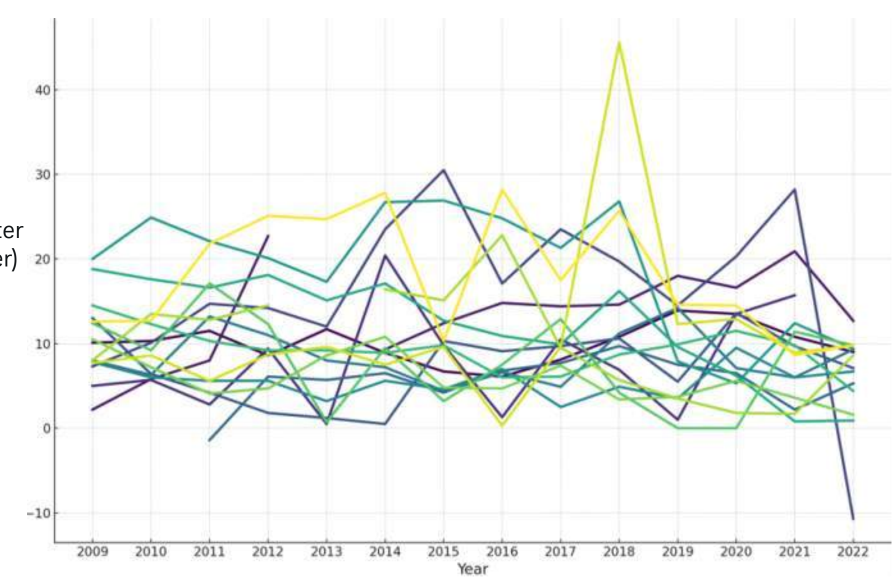
OCPC Region - Unaccounted for water as % of Treated Water

Unaccounted water (% of treated water)



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Water Loss – Preliminary Recommendations

Each year water systems could:

- Conduct water loss audit using AWWA M36 manual and free water loss audit software
- Validate water loss audits using a third-party trained to conduct Level 1 validations pursuant to Water Research Foundation project #5057
- Act on the results by improving data grades and reducing real water losses

Potential demand reductions: Based on study of data from CA, GA, TN and TX, the median utility studied could cost effectively **reduce real water losses by more than 1/3rd; however, reductions vary based on utility-specific factors**

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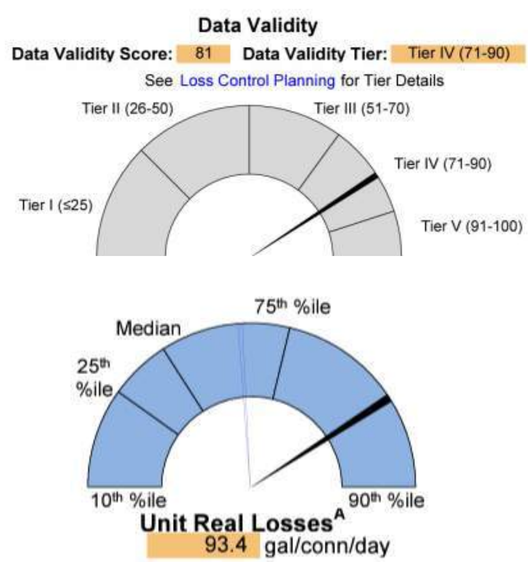
3 benefits of awwa methodology

1. Provides data validity grades
2. Generates actionable recommendations
3. Relies on metered data and validated industry ranges; limited use of estimates



42

Water Loss – Regional recommendation

OCPC or another regional entity could coordinate and assist with grant applications for multiple interested communities in the region and then host regional training.

MassDEP
Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection
100 Cambridge Street Suite 900 Boston, MA 02114 • 617-292-5500

Maura T. Healey
Governor

Kimberley Driscoll
Lieutenant Governor

Rebecca L. Tepper
Secretary

Bonnie Heiple
Commissioner

NOTICE: REQUEST FOR INTEREST

STATEWIDE WATER MANAGEMENT ACT PERMIT AND REGISTRATION HOLDERS

WATER AUDIT

RFI # BWR 2024-AWWA-M36-WATER AUDITS

https://www.mass.gov/doc/m36-water-audit-opportunity-notice-fy2024/download

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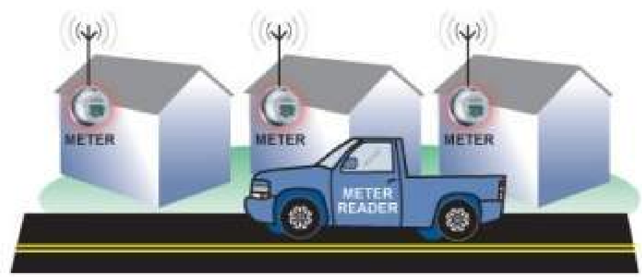
Preliminary Recommendation #2:

implement Advanced metering infrastructure (AMI) & monthly billing

44



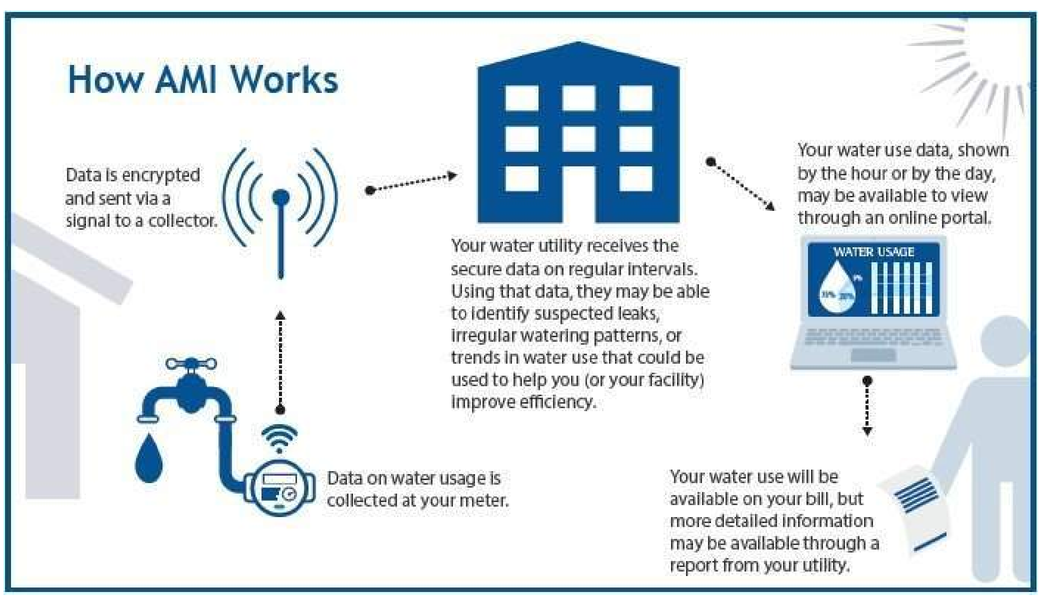
Manual Reading

AMR

AMR = Automated Meter Reading

Source: Presentation by Suez to AWWA Section on April 28, 2022 "Advanced Metering Infrastructure (AMI) Is It Now Within Reach for Small to Mid-Sized Utilities?"

45



Source: www.epa.gov/watersense/advanced-metering-infrastructure

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Metering and billing - Status quo in OCPC Region

<u>Current meter types</u> – Predominantly manual reading and AMR (automated meter reading)

<u>Infrequent Billing</u> – Bimonthly, quarterly, semiannually + ~10 to 30+ days from time meter is read until bills are sent

<u>Impacts on Water Use</u> – customers may be unaware of customer-side leaks for a very long time; limits customer feedback on water usage; limits utility's ability to understand usage during peak months

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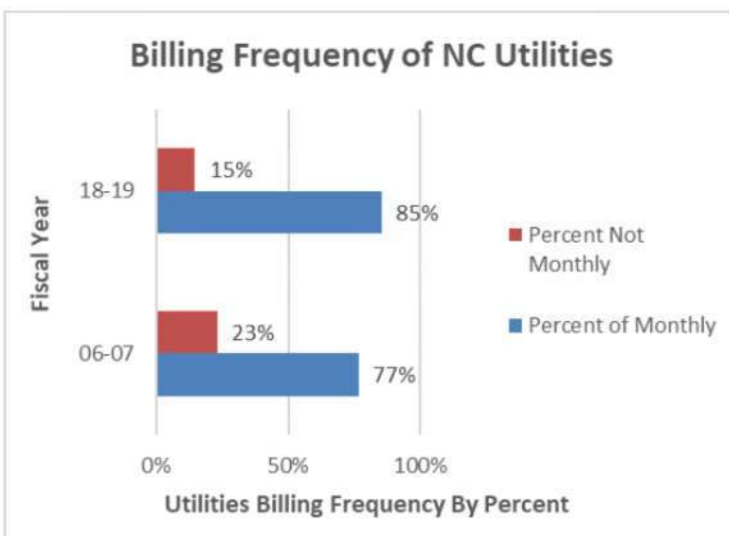
Example of billing practices from NC



Source: https://efc.web.unc.edu/2020/05/07/does-how-often-you-pay-for-it-matter-the-impacts-of-billing-frequency/

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Metering and billing – Preliminary recommendations

Adopt AMI – Adopt advanced metering infrastructure by creating a plan to install AMI meters and related infrastructure for most customer meters (can be phased)

Adopt Monthly Billing – Begin issuing monthly bills (possible even before/without AMI)

Potential demand reductions: AMI metering and monthly billing are best practices; they are necessary building blocks for improved water loss auditing, customer-side leak detection, and improved inclining block rates

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Benefits of AMI

www.awwa.org/Portals/0/AWWA/ETS/Resources/Technical%20Reports/ami_guidebook_feb_2022.pdf

Multiple Benefits

- Improves revenue forecasting
- Reduces bill adjustments
- Improves rate design
- Enables other smart monitoring (e.g. pressure monitoring, leak detection)
- Improves theft detection
- Supports customer service
- Reduces meter reading costs

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Metering and billing – Implementation

Learn More by Joining AWE's Conservation and AMI Users Group (CAMI)*

*CAMI is currently free and open to all

TEMPLATE FOR AN

ADVANCED METERING INFRASTRUCTURE SYSTEM

REQUEST FOR PROPOSALS

Alliance for Water Efficiency

CALIFORNIA WATER EFFICIENCY PARTNERSHIP

A Chapter of the Alliance for Water Efficiency

Note – AWE member only resource

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Preliminary Recommendation #3:

implement customer-side leak detection programs

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Customer-Side leak detection - Status quo

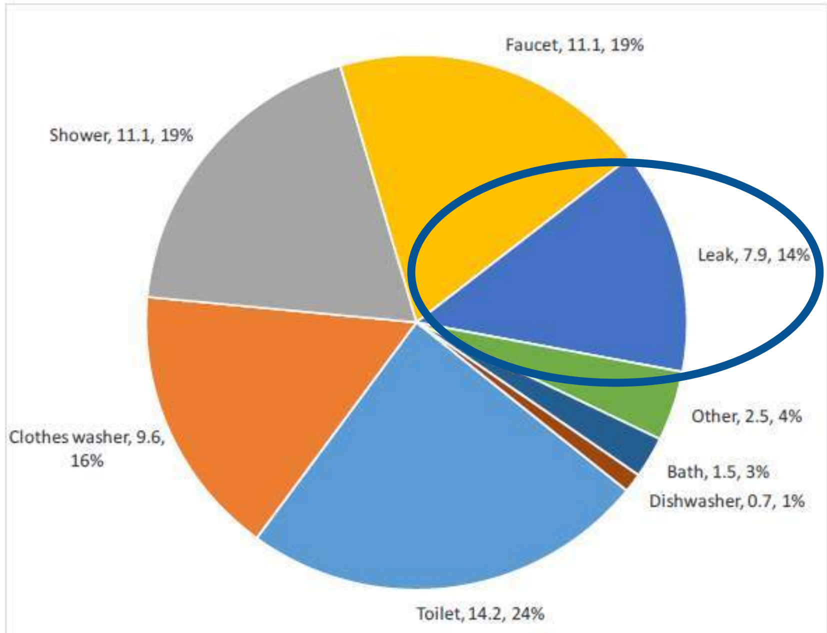

Figure ES.4 Indoor per capita use (gpcd and percent of indoor use) by fixture, 9 study sites, n=737

Source: Residential End Uses of Water Version 2, 2016 (WRF Project No. 4309)

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Customer-side leak detection – Preliminary recommendations

<u>AMI-Based Programs</u>

- Utility periodically sends constant consumption reports; can be automated with AMI interface
- Offer customer-facing portal; customers set constant consumption thresholds

<u>Rebate Programs</u> – Offer a rebate for behind the meter leak detectors

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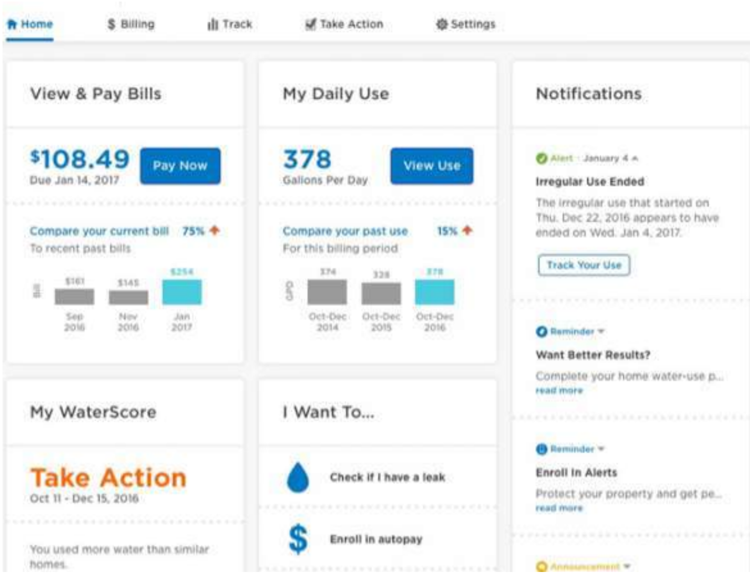
Customer-Facing portal



Potential Demand Reductions: Water savings for enrolled customers range from 2 to 10%; participation is key!

Source: https://www.azwater.gov/sites/default/files/media/2020_TownofPrescottValleyCustomerPortal_Redacted_2.pdf

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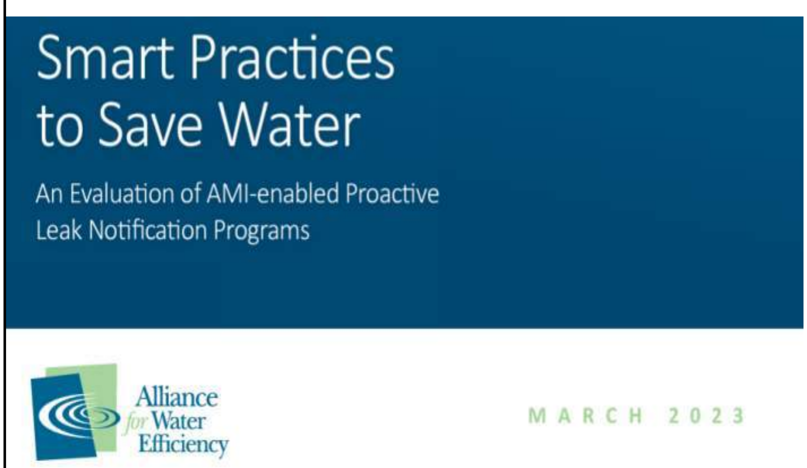
Utility-side Leak Notification Programs



Potential Demand Reductions: Up to 1% savings for overall single-family water use for well designed programs

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Preliminary Recommendation #4:

Improve increasing block rate design

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Water Rate Per Thousand Gallons

Current Rates Effective January 1, 2024

	Quarterly	2023 Per Thousand Gallons	*2024 Per Thousand Gallons*
1st Step	0 -20,000 gals	$5.03	*$5.44*
2nd Step	20,001-50,000 gals	$6.12	*$6.61*
3rd Step	Over 50,000 gals	$7.65	*$8.26*

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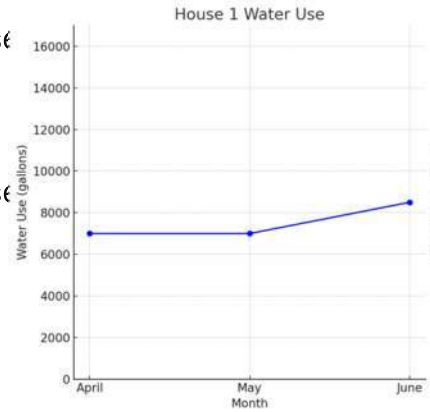
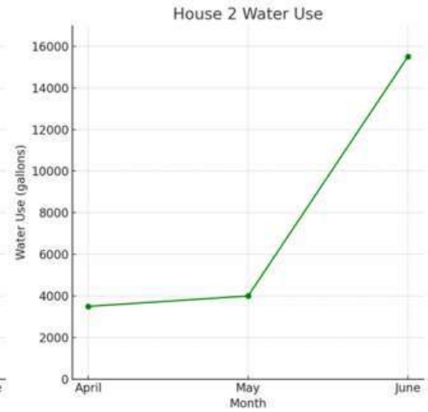
Example of limitation of quarterly billing in rate design

House 1 Quarterly Use
23,00 gallons

House 2 Quarterly Use
23,00 gallons





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Good Example of increasing block rate structure

Proposed Water Blocks	Approx. % of Bills in New Blocks	Water Usage Examples (CF)	Current Monthly Bill	Proposed Monthly Bill	Impact ($)
Basic Needs 0-600	55%	588	$33.97	$33.40	-$0.57
Larger Family 600-1,200	25%	1200	$60.22	$60.88	$0.66
Efficient Irrigation 1,200-2,600	15%	1600	$79.58	$85.04	$5.46
Enhanced Irrigation >2,600	5%	3208	$160.74	$191.28	$30.55

Source: https://www.olatheks.gov/Home/Components/News/News/3362/57

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Improve increasing block rate structures – Preliminary recommendations

Size blocks based on basic indoor use, efficient outdoor use, and excessive outdoor use

Ensure the costs of serving peak customers are allocated to peak customers, which better reflects cost of service, promotes conservation, and improves relative affordability for customers with only basic indoor use

Potential demand reductions: Demand reductions will vary. Poorly designed structures will not reduce demands and well-designed structures **can reduce demands by 10% or more and be revenue neutral**. Revenue and demand impacts of a given rate structure can be estimated as part of a rate study that accounts for price elasticity and strength of the conservation signal.

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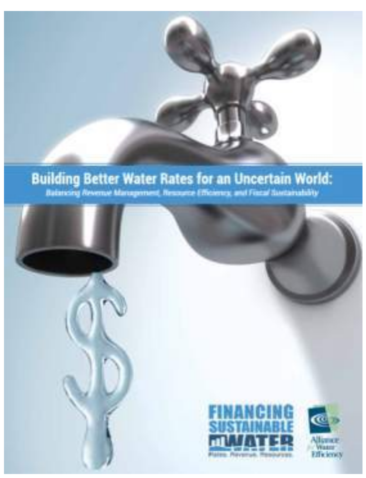
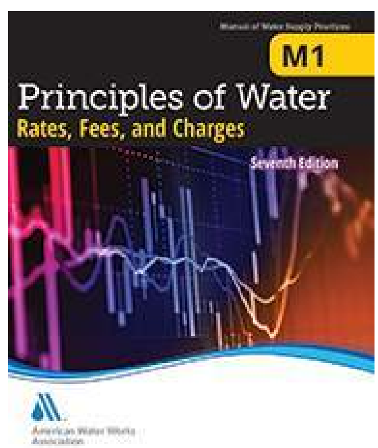
Rate Designs – implementation



Free resource available at www.allianceforwaterefficiency.org/resources/financing-sustainable-water



Available at AWWA bookstore

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Preliminary recommendations for long-term demand reductions

1. Conduct, Validate, and Act on Annual American Water Works Association (AWWA) Water Loss Audits
2. Adopt Advanced Metering Infrastructure and Monthly Billing
3. Implement Customer-Side Leak Detection Programs
4. Improve Increasing Block Rate Designs

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Alliance *for* Water Efficiency

318 W Adams St., Ste. 1514
Chicago, IL 60606

OFFICE 773-360-5100

https://www.allianceforwaterefficiency.org

Alliance *for* Water Efficiency

Thank You!

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Alternatives Introduction

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Hypothetical Alternatives (“Projects/Policies”) for OCPC

Supply Side

- MWRA for all communities
- MWRA for communities abutting Stoughton and Weymouth
- MWRA for communities abutting Weymouth
- More MWRA for Stoughton
- Desalination at max capacity to supply X communities
- Desalination at 80% capacity to retain buffer
- Centralized PFAS treatment facilities
- Decentralized PFAS treatment programs
- Interconnections: A, B, C, D, E, F, ...etc.
- Brackish groundwater
- Stormwater capture
- Reclaimed water for non-potable uses
- Additional operational staff

Demand Side

- Conduct, Validate, and Act on Annual AWWA Water Loss Audits
- Adopt AMI and Monthly Billing
- Implement Customer-Side Leak Program
- Improve Tiered Rate Designs

Examples

66

66

Demand Side Alternatives Discussion

A

People
Pine DuBois
John Haines
Bob Kostka
Kendra Martin
Val Massard
Liz Shea
Dan Sullivan
Kirk

B

People
Jason Duff
Kimberly Groff
Shane O'Brien
Noreen O'Toole
Wayne Parks
Greg Swan
Brian Vasa
Amara

C

People
Jonathan Beder
Peter Gordon
Duane LaVangie
Phil McNulty
Greg Tansey
Kara and Grace Inman

D (hybrid)

People
Peter Forman
Jon Hobill
Gavin Murphy
Jimmy Powell
Brian Vasa
Art Edgerton
Martin Pillsbury
Margherita Prior
Grace Houghton

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Discussion Questions

1. What are your reactions to these preliminary recommendations?
2. Are there demand side management strategies your community already has in place?
3. Are there recommendations that you think your community is more likely to implement?
4. Are there any demand side management that you don't think seem feasible for your community?
5. Are there other demand side management strategies you would like to hear more about?
6. Do you have any additional questions about the recommendations for demand side management presented today?

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Introduction to Demand Projections

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Demand Projections Introduction

- Different methodologies exist with varying cost and complexity
- Methods fall along a spectrum rather than being a strict or exact approach
- Selecting which method depends on purpose of forecast (e.g., policy vs master planning), data availability and quality, cost and time constraints, and importance of geospatial accuracy

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Demand Projections Methodology

- Econometric Function
  - Form of regression analysis that incorporates economic variable(s)
  - Assumes ***per unit water use*** (dependent variable) is a **function** of several ***explanatory factors*** (independent variables)
  - Unit use rate changes over time as those explanatory factors change
- Variables included in function are based on iterative process to determine combination with highest correlation with historical water use
- Adjusted R^2 to measure correlation – adjusts for number of terms in model, only increases if new variable improves model

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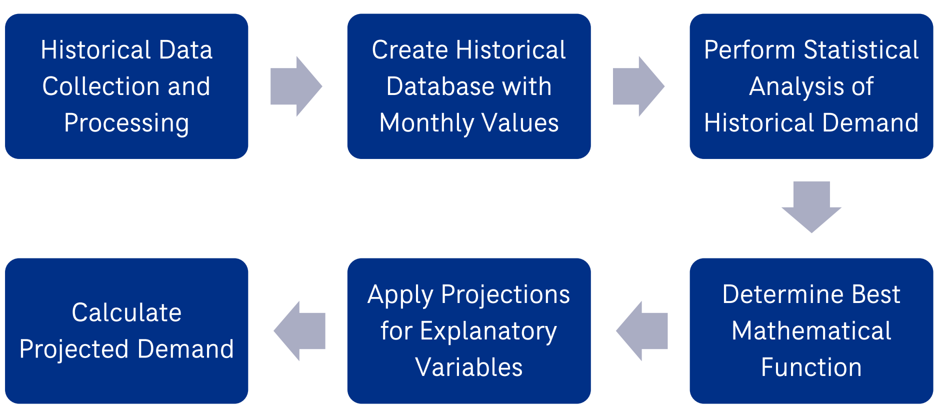
Overview of Econometric Demand Projection Process



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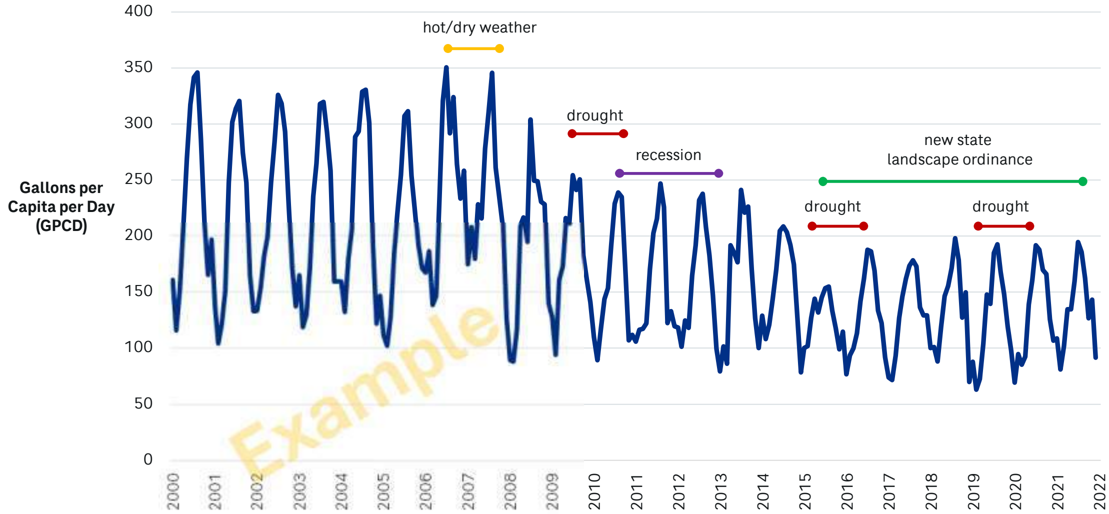
Example of Historical Water Use Trends and Impacts



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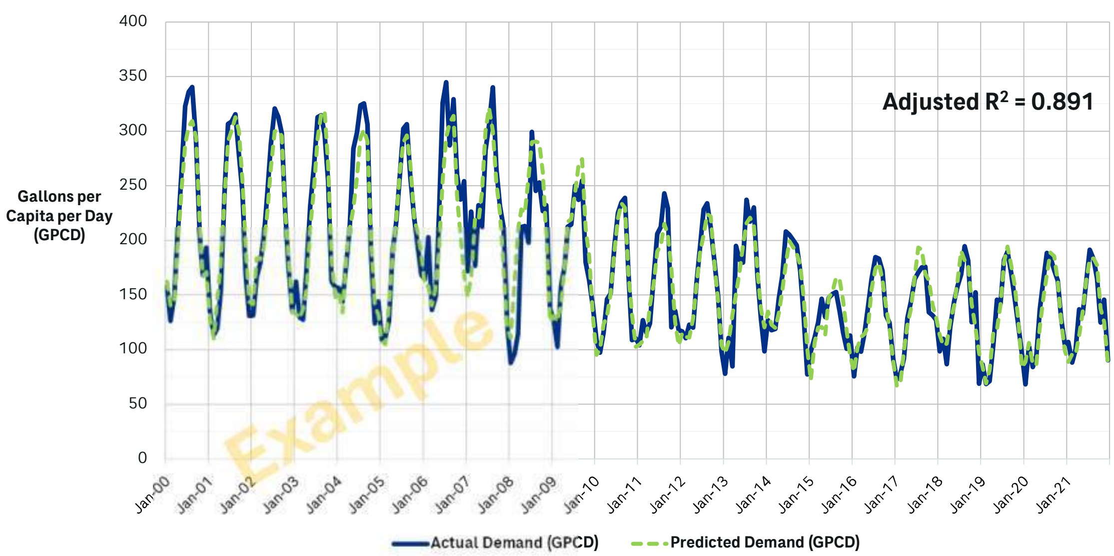
Example Demand Model Verification



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Next Workshop

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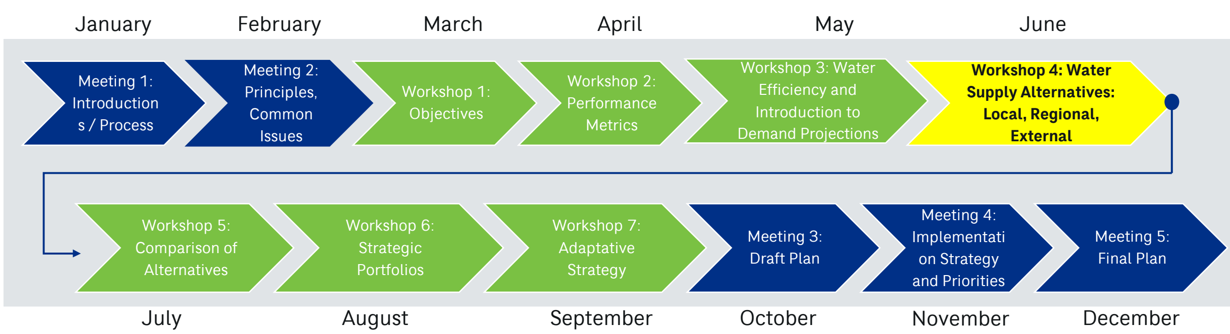
Next Workshop



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Upcoming Schedule

WHEN	DETAILS
Tuesday, June 25th 9:00 am – 12:00 pm	Workshop 4
Wednesday July 31st 9:00 am – 12:00 pm	Workshop 5
Tuesday, August 27th 9:00 am – 12:00 pm	Workshop 6
Tuesday, September 24th 9:00 am – 12:00 pm	Workshop 7
Tuesday, October 29th 9:00 am – 12:00 pm	Meeting 3
Monday, November 18th 8:00 am – 12:00 pm	Meeting 4
Tuesday, December 10th 8:00 am – 12:00 pm	Meeting 5

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Feedback Survey

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Last Meeting: Feedback Survey Results

1. Please tick one box per row.
The meeting had a clear agenda.
Facilitation of today's meeting was effective.
I had plenty of opportunity to participate in the discussion today.
Interactions were positive and respectful.
I understand where we are in the process and where we are going.

Strongly disagree	Disagree	Agree	Strongly agree

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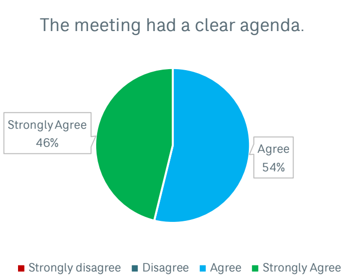
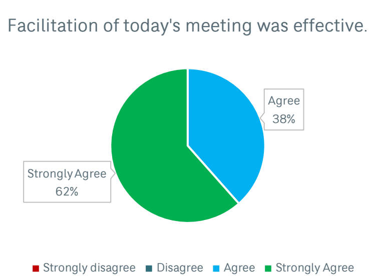
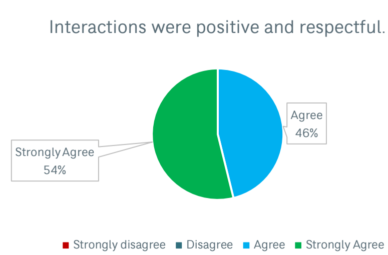
Last Meeting: Feedback Survey Results





Legend
- Strongly Agree
- Agree
- Disagree
- Strongly Disagree



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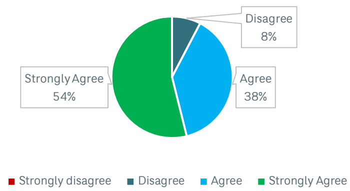
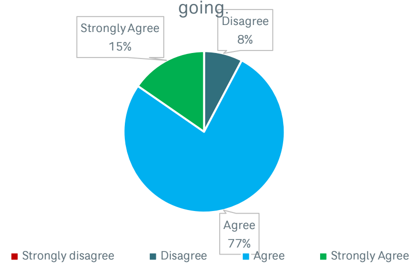
Last Meeting: Feedback Survey Results

I had plenty of opportunity to participate in the discussion today.



I understand where we are in the process and where we are going.



Legend
- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

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Appendix F
Steering Committee Workshop 4
06-25-2024

OLD COLONY PLANNING COUNCIL

Rebecca Coletta, President | Mary Waldron, Executive Director

(508) 583-1833 | 70 School Street, Brockton, MA 02301 | www.oldcolonyplanning.org

Regional Water Plan
Steering Committee Meeting
MINUTES OF THE MEETING
Tuesday, June 25, 2024, 9:00am

Location: Old Colony Planning Council, 70 School St, Brockton, MA 02301

Attendees:

Steering Committee	
Organization	**Name**
Town of Abington	Liz Shea (via Zoom)
Town of Abington	Scott Lambiase (via Zoom)
Town of Avon	Jonathan Beder
Town of Bridgewater	Shane O'Brien
City of Brockton	Pat Hill
CPCWDC	Kimberly Groff (via Zoom)
CPCWDC	Art Egerton
East Bridgewater	John Haines
Easton Department of Public Works	Greg Swan
Town of Kingston	Val Massard
MA Department of Conservation and Recreation	Jason Duff
MAPC	Martin Pillsbury (via Zoom)
MassDEP	Duane LeVangie
MassDEP	Jon Hobill (via Zoom)
Pembroke Water Department	Dan Sullivan
OCPC	Joanne Zygmunt
Town of Plympton	Gavin Murphy (via Zoom)
Town of Stoughton	Phil McNulty
Watershed Associations	Pine duBois
Watershed Associations	Jimmy Powell (via Zoom)
Town of West Bridgewater	Wayne Parks

Observers	
Organization	**Name**
OCPC	Becky Coletta (via Zoom)
OCPC	Mary Waldon (via Zoom)
Cape Cod Cranberry Growers' Association	Brian Wick

Consultants	
Organization	**Name**
CDM Smith	Grace Houghton
CDM Smith	Kirk Westphal
CDM Smith	Amara Regehr
CDM Smith	Grace Inman
CDM Smith	Kara Rozycki
Alliance for Water Efficiency	Andrew Morris (via Zoom)

Minutes:

1) Call to Order, introductions

2) Public Comment – none

3) Request for feedback on metrics

   a) Discussion of water quantity and quality standards being incorporated. (example: Do the metrics include specifics on having enough supply to support the river downstream/support fish migration)

   b) Environmental roundtable will be coming up soon

   c) Communicating the water science to public will be very important

   d) Public forums upcoming to gain public input

   e) Hull, MA water demand issues mentioned

4) Demand Projections and Water Efficiency and Discussion

   a) Presentation on CDM Smith demand projections

   b) Questions and comments discussed:

      i) Question on water supply source affecting water availability – this is not incorporated into the water demand analysis

      ii) Question on water restrictions affecting the model – they are not directly incorporated into the model as they are covered by other statistically significant variables.

      iii) Question on median household income not statistically significant – this was a surprise to the group

iv) Discussion of showing summer peaks in the demand analysis

v) Discussion of MBTA and other growth being included into the stressed scenario via 10% increase

vi) Efficiencies override population growth. Projections assume current technology efficiencies.

vii) Concern with baseline on averages. Team will assess seasonal/monthly approaches.

viii) Recommendation for a rebate program for water efficiency.

ix) Projections to be reviewed in more detail with DCR.

5) Risk Analysis

a) Memos will be distributed to each municipality to review

b) Source capacity demonstrates hydraulic ability of well, or surface water infrastructure

c) Historic water use is shown in annual average.

d) Requested to add peaks into Graph A

e) Edit desalination header in risk category

f) Additional Risks discussed: politics, lack of oxygen, public acceptability

6) Introduction to Water Supply Alternatives

a) Process of alternative development and assessment reviewed by CDM Smith

b) Request to incorporate timing into the process. Could be short-term/long-term.

7) Water Supply Alternatives Small Group Discussion

a) What are you committed to right now and in the next 5 years?

b) Longer term, do you feel there is a need for redundancy for drought, cyber security, short term issues or other concerns? Are you open to the following: MWRA, Desalination, Municipal interconnections, reclaimed water for non-potable uses, other?

c) What are actions that your organization would like to see included in the Regional Water Plan?

8) Water Supply Alternatives Group Discussion

a) What are you committed to right now and in the next 5 years?

i) Municipalities:

(1) PFAS Treatment (testing, design and construction, investment)

(2) Maintaining and improving existing infrastructure

(3) Main replacement and removing lead services

(4) Water quality monitoring

(5) Addressing Water System Master Plans

(6) Expanding municipal groundwater wells

(7) Sustainable access to clean water for private well owners

ii) Watershed Associations

(1) Restoring ecosystem health through connectivity, water quality, habitats and natural flow, fish migration to recover populations, remove unnecessary obstructions

iii) Massachusetts Cranberries

(1) Research to decrease water use in agriculture

b) Longer term, do you feel there is a need for redundancy for drought, cyber security, short term issues or other concerns? Are you open to the following: MWRA, Desalination, Municipal interconnections, reclaimed water for non-potable uses, other?

i) Communities present agree that there is a need for redundancy against risks

ii) The following communities indicated they were open to considering the MWRA as a supply source for redundancy: Abington, Plympton[1], Easton, Pembroke, Bridgewater, West Bridgewater, Stoughton

iii) The following communities indicated they were open to considering more municipal interconnections as a supply source for redundancy: Abington, Plympton*, Easton, Bridgewater, West Bridgewater, Stoughton

iv) The following communities indicated they were open to considering more reclaimed water for non-potable use as a supply source for redundancy: Plympton*, Easton, Bridgewater, West Bridgewater

v) Other water supplies included:

(1) work on a regional level for green infrastructure/stormwater capture, reuse with multiple benefits

(2) For impaired sources, struggle to manage water levels. Recommend a more collaborative approach to managing ecological functions in addition to supply functions

(3) More oversight (perhaps at state level) for commercial water brokers who pump large amounts of groundwater and truck it out of the area

---

[1] Plympton is open to all alternatives, but cost effectiveness will likely affect decision for their 1,000 users. Having no water supply backup is a concern.

(4) Crisis prepared sharing, need to consider inter-basin transfer

(5) Improvements to desalination technology as well as using renewable energies such as solar, wind or tidal to power.

c) What are actions that your organization would like to see included in the Regional Water Plan?

i) Actions that promote sustainability and which are not piped infrastructure dependent

ii) Options for short-term and long-term solutions to water supply

iii) Resource center to reduce water consumption (potentially online website)

iv) Reliable water supply and quality

v) Sensible water consumption

vi) High / equal priority for vibrant ecosystems to sustain future and current populations

vii) More desalination development and use (powered by renewable energy)

viii) MWRA purchase of Aquaria desalination plant, upgrades it and uses it to supply multiple communities back up/ supplemental supply

ix) Reduction to water use for landscaping through education

x) More use of native landscaping, with need for workforce development with landscapers

xi) Establish minimum flows for healthy streams and wetlands

xii) Reliable water supply

xiii) Limit private well irrigation during droughts. Could be through a mandate from Boards of Health.

xiv) Open planning and decision making based on ecology which includes humans- not profit based

xv) Reductions and explanations for unaccounted for water

xvi) Consider water quality when emergency diversions occur to mitigate flooding

xvii) Unaccounted for water loss is controlled.

xviii) Costs are equalized according to revenue

xix) Maximize town / city interconnections for systems with compatible water supplies through inter municipal agreements

xx) Importance of agricultural water use in the region in terms of both quantity and quality

xxi) Opportunity for involvement in programs that may allow for decrease in water use through grants, infrastructure, and research xxii)Reliable water supply

xxiii) Consideration of water need by growers in dam removal (nitrification?)

xxiv) Seat of agricultural users at the table in policy discussions

xxv) Support additional water sources to meet impacts of climate change

xxvi) Reinvigorate extension programs for public education

9) Next Workshop

a) 7/31/2024

Action Items:

Assigned to	Action Item
Steering Committee members	Submit final annotated bibliography comments
Steering Committee members	Respond to interview requests
Steering Committee members	Complete weighting worksheet on behalf of your community/organization
CDM Smith	Finalize memos (Efficiency, Water Demand, Individual Town Capacity/Demand) and distribute to steering committee

Attachments:

1. Meeting Presentation Slides
2. Meeting Handouts

Prepared by CDM Smith.

Old Colony Planning Council Regional Water Plan

Workshop 4

Economic Resilience and Sustainable Water Supply

Kirk Westphal, Kara Rozycki, Tarun Gill, Brian Shepard, and Amara Regehr

June 25, 2024

Central Plymouth County Water District Commission

SOUTH SHORE CHAMBER OF COMMERCE

CDM Smith

1

Agenda

1. Public Comment
2. Comments on Updated Metrics
3. Demand Projections and Water Efficiency
4. Discussion on Demand Projections and Water Efficiency Recommendations
5. Risk Analysis

Coffee Break

6. Introduction to Water Supply Alternatives
7. Water Supply Alternatives Small Group Discussion
8. Next Workshop

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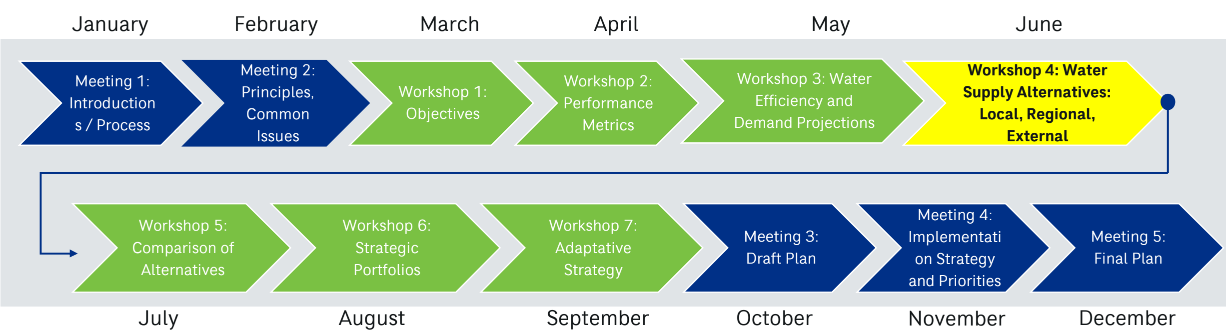
2

Public Comment

3

Overview of Regional Water Plan Process



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4

Comments on Updated Metrics

5

Comments on Updated Metrics

- Updated metrics sent out in advance of this meeting (on June 18th).
  - Request for Metrics Feedback by July 3, 2024

6

Demand Projections and Water Efficiency Recommendations

7

Demand Projections Introduction

- Different methodologies exist with varying cost and complexity
- Methods fall along a spectrum rather than being a strict or exact approach
- Selecting which method depends on purpose of forecast (e.g., policy vs master planning), data availability and quality, cost and time constraints, and importance of geospatial accuracy

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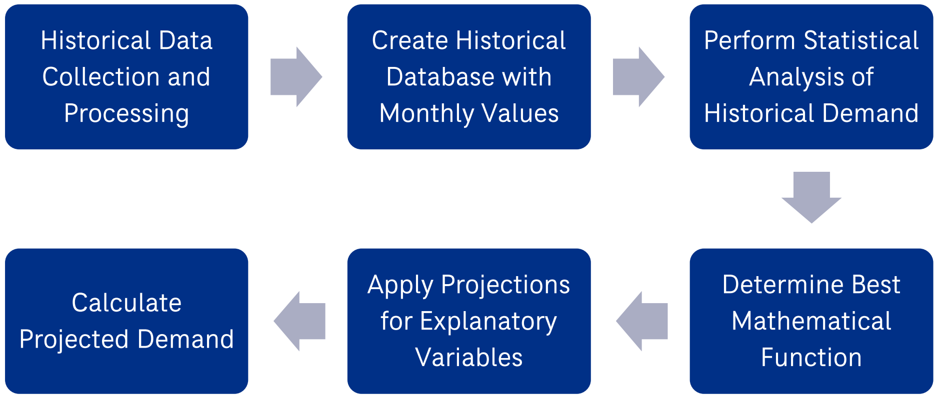
Overview of Econometric Demand Projection Process



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List of Data Used in Analysis

Statistically Significant Variables (Included in Model)	Statistically Insignificant Variables (Not Included in Model)
Average maximum temperature	Average minimum temperature
Number of days in a month above 85°F	Max temperature in prior month
Total monthly precipitation	Number of days in a month above 90°F and 80°F
Total monthly precipitation in prior month	Number of days in a month without precipitation
Indoor water use efficiency index	Unemployment rate
Summer months (June, July, August) (binary)	Median household income

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Explanatory Variables included in Demand Analysis

Temperature

10% increase in max temperature	=	**2.12% increase** in demand
10% increase in number of days over 85°F	=	**0.34% increase** in demand
10% increase in both	=	**2.46% increase** in demand

Precipitation

10% decrease in total precipitation = **0.99% increase** in demand

Efficiency Index

10% increase in water use efficiency = **9.39% decrease** in demand

Summer Months

In the months of **June, July, and August** → **9.76% increase** in demand

Impact over the **entire year** → **2.44% increase** in demand

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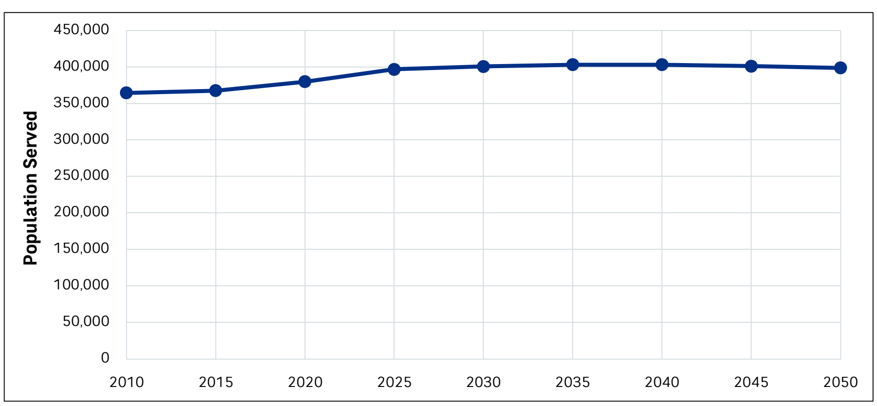
Population Estimates

- Projected population from UMass Donahue Institute (same as DCR)
- Population served is projected to **increase 6.1%** between 2020 and 2035
- Population served is then projected to **decrease 1.1%** between 2035 and 2050



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Future Scenarios for Planning

Planning Scenario	Population Growth	Future Climate Change	Water Use Efficiency	Trend in UAW	Private Wells to Public Supply
1. **Baseline**	Expected	Historical Average	Average increase in efficiency	Historical Average	None
2. **Low Stress**	Expected	Cool/Wet	Greater than average increase	Decrease	None
3. **Significant Stress**	10% greater than expected	Hot/Dry	Less than average increase	Increase	100%*
4. **Significant Stress with Mitigation**	10% greater than expected	Hot/Dry	Greater than average increase	Decrease	100%*

*100% of private wells from publicly available data. Not a comprehensive list.

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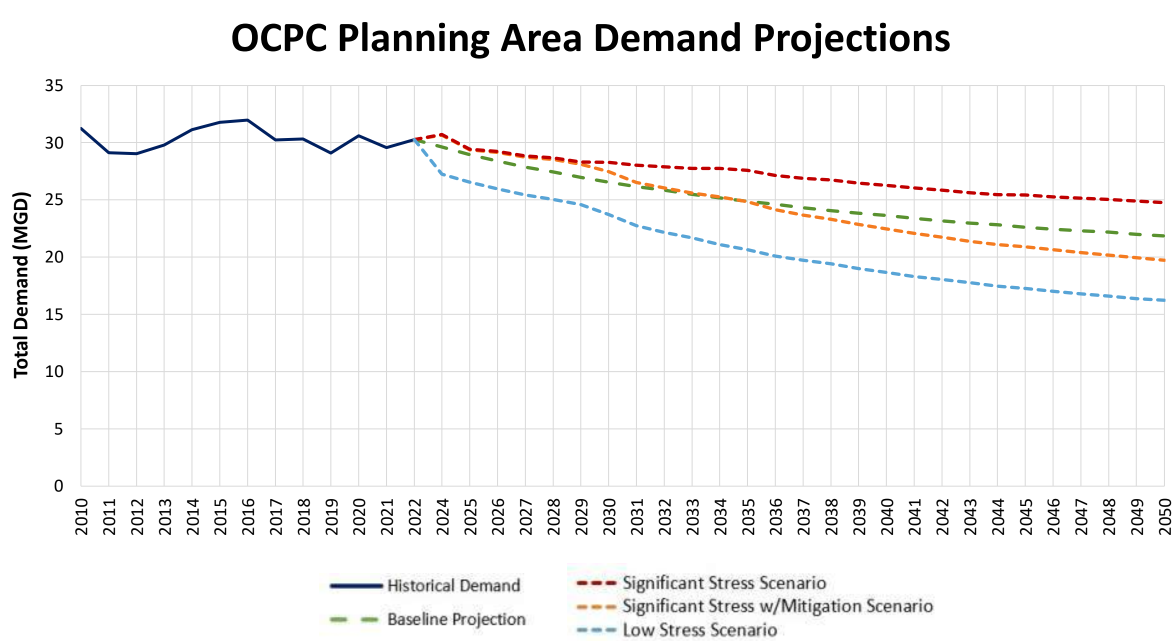

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Indoor Water Use Efficiency Index: Passive Conservation

- **Massachusetts Efficiency Standards**
  - Enacted Jan 1, 2023. Applies to faucets, showerheads, and toilets sold in Massachusetts
  - More stringent than existing Federal standards, results in 22.5% reduction for those end uses
- **Department of Energy (DOE) Standards**
  - Applies to residential clothes washers sold in U.S.
  - Latest standard is approx. 45% more efficient for top loaders and 60% more efficient for front loaders compared to estimated efficiency in 2016*
- **Flume Water data**
  - Real world water use data for Boston metro area indicates current indoor use of 34 GPCD**
  - OCPC planning area indoor water use is estimated at approx. 46 GPCD, indicating reduction of 12 GPCD (-26%) is obtainable with available fixtures and appliances

*Based on *2016 Residential End Uses of Water* from Water Research Foundation (Project #4309)
**Available at: https://flumewater.com/water-index/

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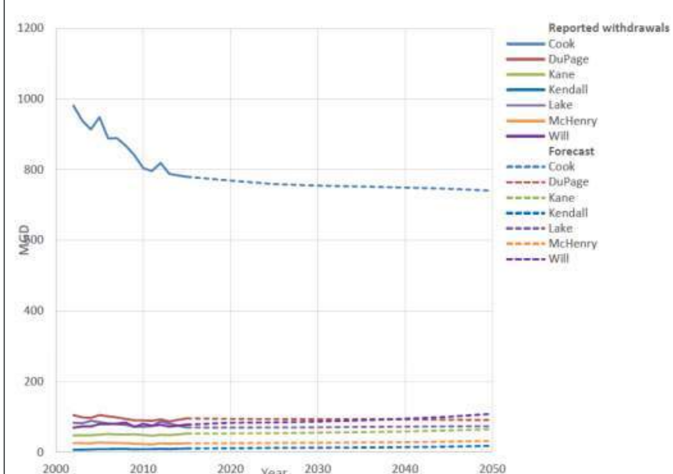
Impact of Passive Conservation on Total Demand

- Example from Illinois
  - **Demand** is projected to **decrease** over the planning horizon
  - **Population** growth is projected to be **relatively flat**
  - Improved **efficiency** drives the **decrease** in **demands**
  - No state efficiency standards

Figure 3.3. Regional water demand forecast by county, reported withdrawals and forecast, MGD



Source: CMAP ON TO 2050 Regional Water Demand Forecast.

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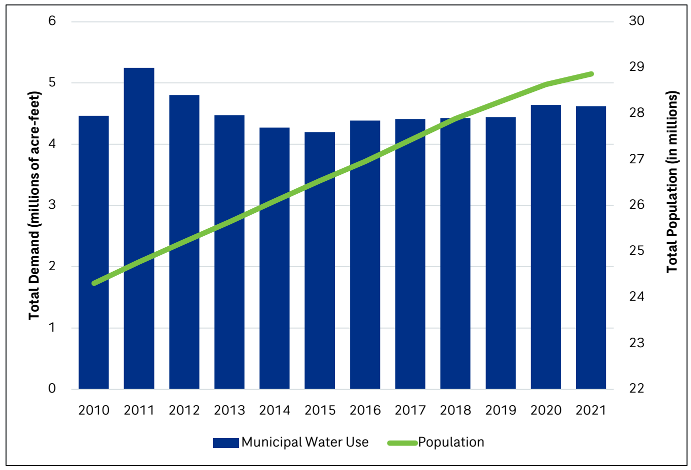
Impact of Passive Conservation on Total Demand

- Example from Texas
  - Total municipal use has been **relatively steady** between 2012 and 2021 **despite population increase** of 3.65 million (14.5%)
  - **Per capita** demand decreased 16% between 2012 and 2021
  - State efficiency standard implemented in **2014** more stringent than Federal standard



Sources: Texas Water Development Board and U.S. Census Bureau

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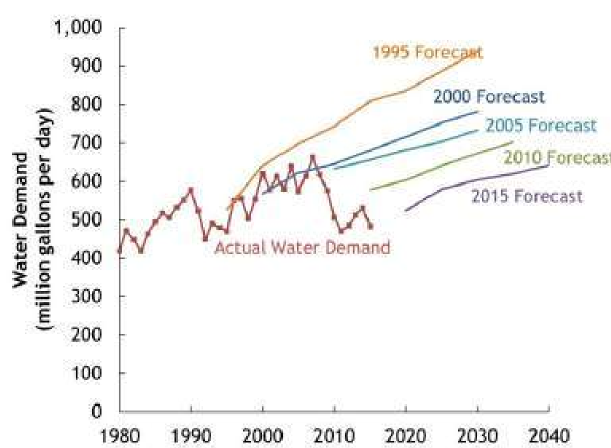
Impact of Passive Conservation on Total Demand

- Changes in per capita demand from passive conservation are often not accounted for in demand projections
- Typical approach is a trend extrapolation
- Examples of demand projections overestimating demands are available across the U.S.

Demand Projections for San Diego, California



Source: Alliance for Water Efficiency

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Summary of Demand for Communities

The minimal increase in population served and increased water use efficiency over the planning horizon produces a downward trend in water demand for the OCPC planning area through 2050.

Community	Percent Change in Demand by 2050
Abington	-22.6%
Avon	-36.0%
Bridgewater	-29.4%
Brockton	-24.4%
Duxbury	-32.1%
East Bridgewater	-26.4%
Easton	-37.9%
Halifax	-36.3%

Community	Percent Change in Demand by 2050
Hanover	-28.5%
Hanson	-32.0%
Kingston	-22.1%
Pembroke	-33.7%
Plymouth	-26.7%
Stoughton	-36.9%
West Bridgewater	-22.3%
Whitman	-29.7%

Compared to historical average water use by community for 2016-2022

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Alliance for Water Efficiency (AWE) Recommendations Update

- AWE will issue a memorandum summarizing their recommendations
- Recommendations for utilities include:
  1. Conduct, Validate, and Act on Annual American Water Works Association Water Loss Audits
  2. Adopt Advanced Metering Infrastructure and Monthly Billing
  3. Implement Customer-Side Leak Detection Program
  4. Improve Increasing Block Rate Designs

- **Consider collaborating on water efficiency and water conservation measures for communities with shared water sources**

Alliance for Water Efficiency

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RM0

Public Water Supply Watershed Sources

South Coastal Basin	Combination	Taunton River
- Duxbury - Hanover - Kingston - Pembroke - Plymouth	- Abington - Brockton -Whitman*	- Avon - Bridgewater - East Bridgewater - Easton - Halifax - Hanson - West Bridgewater

* Whitman purchases its public water supply from Brockton

Note: Plympton not included as there is no public water supply, but private well users span both South Coastal Basin and Taunton River Watersheds

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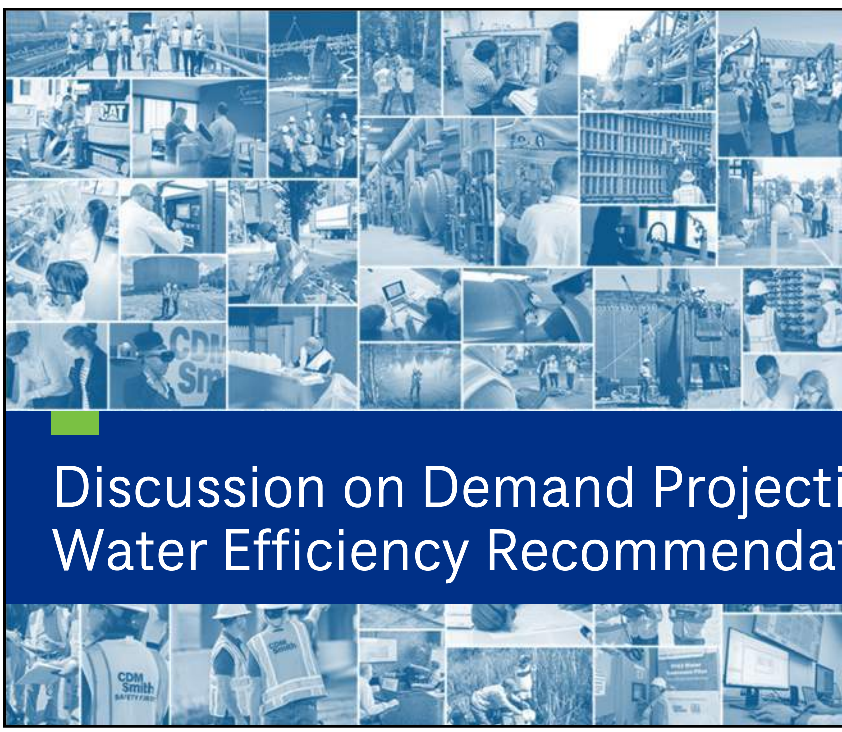

Discussion on Demand Projections and Water Efficiency Recommendations

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Discussion on Demand Analysis and Water Efficiency

- Demand Analysis
  - What are your thoughts on the demand analysis for the region?
  - Do the scenarios adequately provide a range of future scenarios useful for planning purposes?
- Water Efficiency
  - Is there interest in collaboration across watershed source waters for water conservation measures?
  - Is there interest in collaboration across watershed source waters for resource protection?
  - If so, what could this look like?

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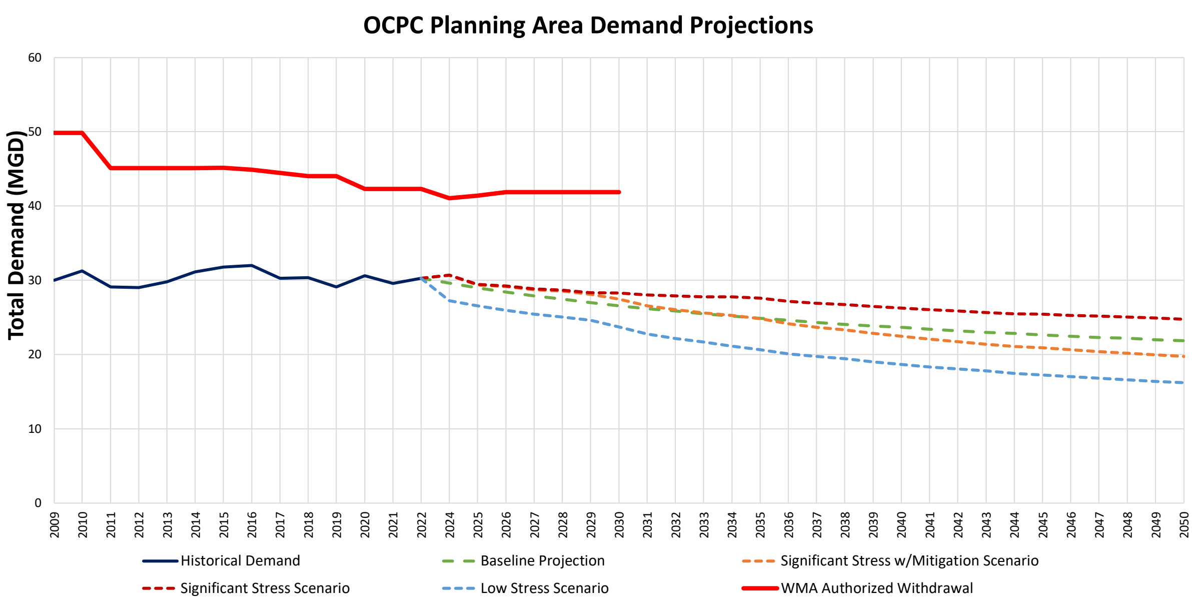

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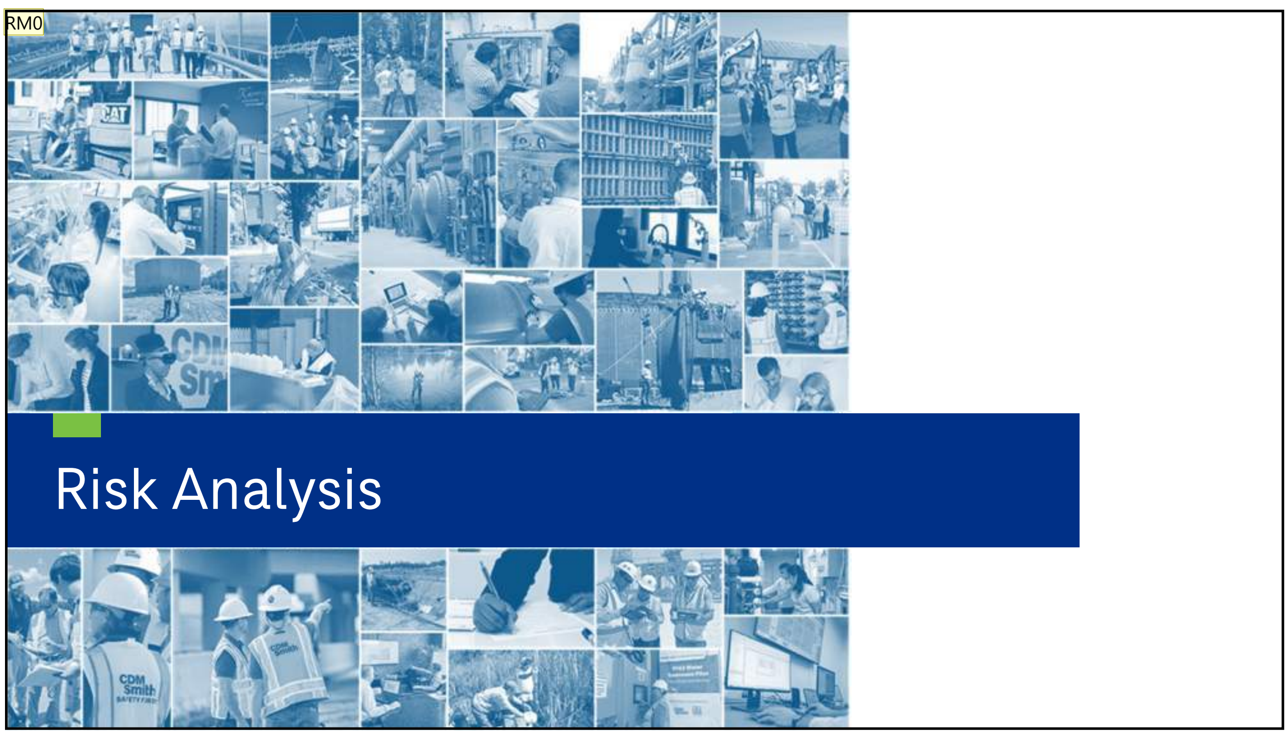

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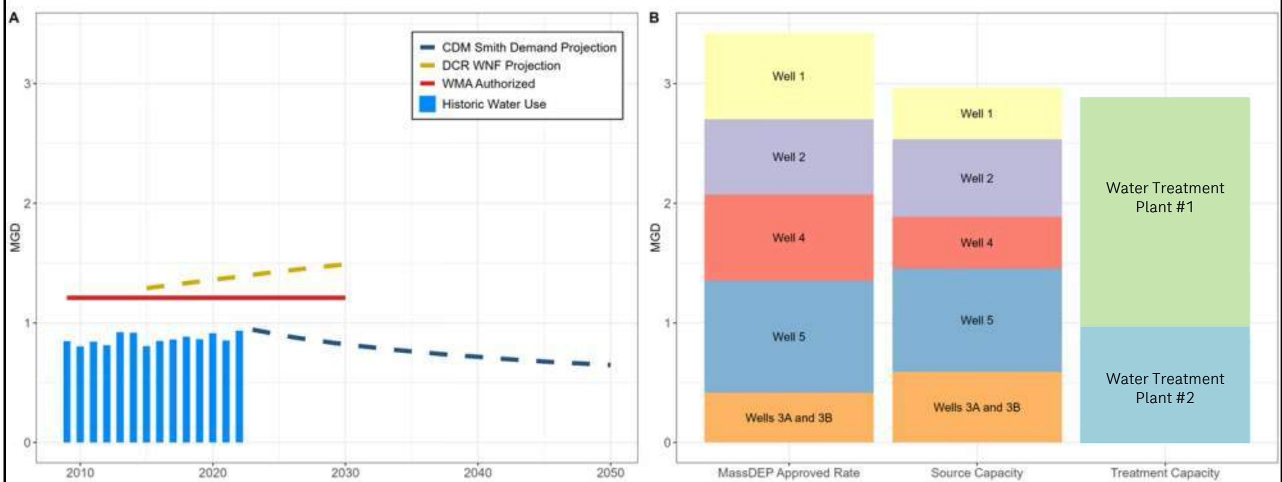
Risk Analysis -
Demand Projections and Capacity Memo

Feedback requested by 7/12 via email



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Risks/Uncertainties That Could Help Shape the Plan

Are these and other risks important to mitigate in the Regional Water Plan?

- Supply Risks
  - Climate Change
    - More Droughts
    - Sea Level Rise / Saltwater intrusion
  - PFAS
    - More public sources
    - Private wells
  - Desalination
    - Funding challenges
- Demand Risks
  - Climate Change
    - Less summer rain, higher temps
    - Private wells seeking public supply
  - Population
    - Growth outpaces projections
  - Water Use Efficiency
    - Projections not met
    - Aging infrastructure
- Ecological Risks
  - Climate Change
    - Lower flows
    - Lower water table
  - Development
    - Reduced open space and ecological connectivity
  - Water Quality
    - Nutrients/Algae
    - Toxins
    - Other
- Policy/Regulatory Risks ARO
  - MBTA Zoning
  - WMA Renewals
  - State/Federal drinking water regs
  - Reclaimed water regs in MA
  - Economic policy / borrowing rates

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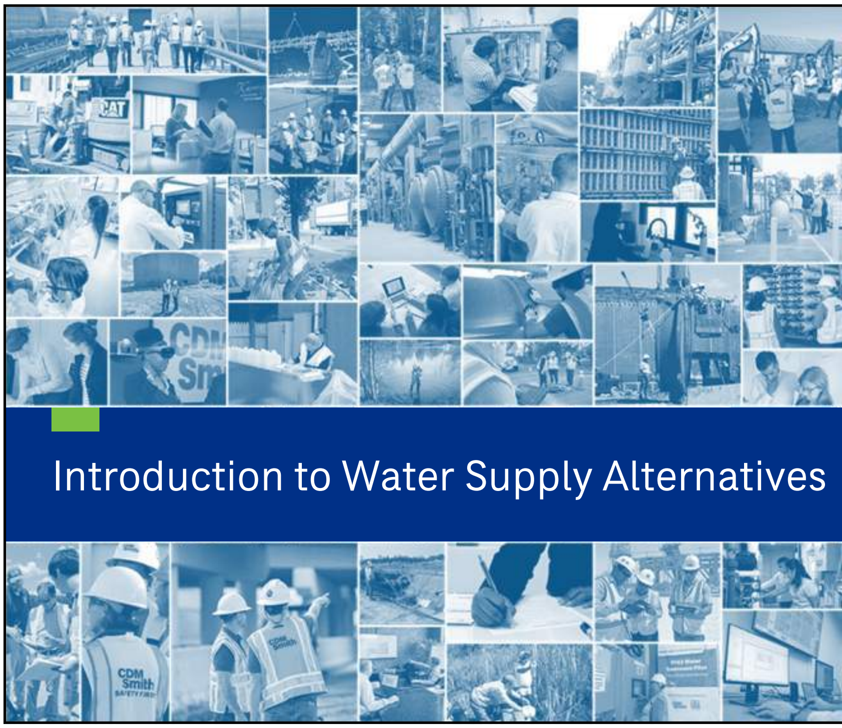

Introduction to Water Supply Alternatives

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Update on Interviews with Municipalities

Abington	Avon	Bridgewater	Brockton	Duxbury
East Bridgewater	Easton	Halifax	Hanover	Hanson
Kingston	Pembroke	Plymouth	Plympton	Stoughton
	West Bridgewater	Whitman		

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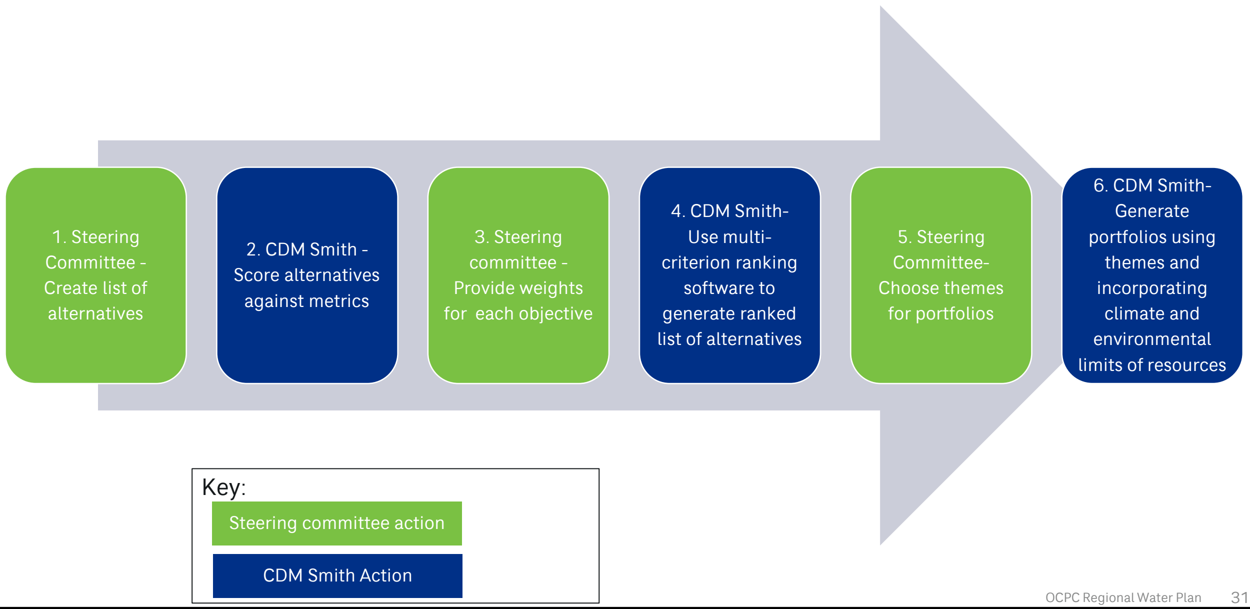
Upcoming steps for selection of alternatives



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Hypothetical Alternatives ("Projects/Policies") for OCPC

Supply Side

- MWRA for all communities
- MWRA for communities abutting Stoughton and those abutting Weymouth
- MWRA for communities abutting Weymouth
- More MWRA for Stoughton
- Desalination at max capacity to supply X communities
- Increasing capacity of desalination to supply to X communities
- Inter-municipal PFAS treatment facilities
- Individual municipal PFAS treatment facilities
- Municipal Interconnections for Supply
- Additional Municipal Wells
- Stormwater capture
- Reclaimed water for non-potable uses

Examples

Demand Side

- Conduct, Validate, and Act on Annual AWWA Water Loss Audits
- Adopt AMI and Monthly Billing
- Implement Customer-Side Leak Program
- Improve Tiered Rate Designs

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Score Projects Against Metrics

Objectives	Reliable Municipal Supply		Cost Effectiveness	Ecological Health	Innovation	Fairness		Drinking Water Quality	Efficiency and Adaptability	
Alternatives										
MWRA for all communities	100%	10%	20M/benefit	5	2	0.1	3	100%	1	5
MWRA for communities abutting Stoughton and abutting Weymouth	70%	4%	12M/benefit	3	2	0.4	2	70%	1	3
MWRA for communities abutting Weymouth	...							...		
More MWRA for Stoughton	...							...		
Desal at max capacity to supply X communities	...							...		
Desal at 80% capacity to retain buffer										
Centralized PFAS treatment facilities	75%	15%	18M/benefit	3	1	0.6	1	75%	1	2
Decentralized PFAS treatment programs	...							...		
Interconnections: A, B, C, D, E, F, ...etc.	...							...		
Brackish groundwater	...							...		
Stormwater capture	5%	0%	4M/benefit	3	3	0.8	1	5%	1	1
Reclaimed water for non-potable uses										
Unaccounted-For Water reductions	80%	15%	6M/benefit	4	1	0.4	1	80%	5	4

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Collect Stakeholder Weights

	Reliable Municipal Supply	Cost Effectiveness	Ecological Health	Innovation	Fairness	Drinking Water Quality	Efficiency and Adaptability
Stakeholder A	50	10	10	5	15	5	5
Stakeholder B	25	10	25	10	10	10	10
Stakeholder C	5	5	5	60	10	5	10
Stakeholder D	20	5	5	5	10	15	40
Stakeholder E	5	5	70	5	5	5	5
Stakeholder F	14.3	14.3	14.3	14.3	14.3	14.3	14.3
Stakeholder G	...	...	...	...			
Stakeholder H	...	...	...				
Stakeholder I	...	...					
Stakeholder J	...						

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Use Multicriteria Ranking Software to Generate Ranked Lists of Projects

Sort on Average Rank

Examples:
Results entirely random

	Average	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
		STAKEHOLDERS																
Unaccounted-For Water reductions	2.4	2	1	3	3	1	3	4	3	2	2	1	3	4	3	1	2	3
Desal at 80% capacity to retain buffer	3.0	1	3	5	2	5	4	5	2	1	1	3	2	5	4	3	3	2
MWRA for communities abutting Weymouth	3.6	6	4	6	4	2	1	3	6	6	3	2	1	2	2	5	7	1
Centralized PFAS treatment facilities	3.8	3	5	2	1	3	7	2	5	3	4	5	5	1	6	4	4	5
Incentivize 60 gpcd for all residential users	4.6	7	7	4	5	7	6	1	7	8	5	4	7	3	1	2	1	4
Other water efficiency measures	8.3	4	2	8	15	11	9	6	1	10	11	7	11	12	9	7	9	9
Reclaimed water for non-potable uses	9.2	13	8	1	6	6	2	14	8	13	8	17	8	10	5	13	14	11
Outreach to encourage water conservation	9.2	5	6	7	16	12	8	15	4	4	10	6	10	11	15	10	11	7
Interconnections: A, B, C, D, E, F, ...etc	9.8	10	10	14	8	16	12	11	11	5	9	13	6	7	8	9	12	6
Decentralized PFAS treatment programs	9.8	9	11	13	9	15	11	10	12	7	6	11	4	6	16	8	10	8
Brackish groundwater	10.4	11	9	16	7	4	10	13	10	14	7	14	9	9	7	12	15	10
Grey water recycling for industries	10.8	16	15	9	13	10	5	7	9	9	12	8	12	13	13	14	6	13
More MWRA for Stoughton	12.2	14	14	10	12	13	17	8	14	16	13	9	15	14	10	6	5	17
Desal at max capacity to supply X communities	13.0	8	12	11	17	14	16	9	16	12	14	10	16	17	14	15	8	12
MWRA for communities abutting Stoughton and Weymouth	13.5	12	13	17	10	8	14	17	15	15	17	12	13	8	12	16	17	14
Stormwater capture	13.6	15	17	12	11	9	13	16	13	11	15	16	17	16	11	11	13	15
MWRA for all communities	15.6	17	16	15	14	17	15	12	17	17	16	15	14	15	17	17	16	16

Consistently High Ranking for all Stakeholders: Build portfolios starting with these

Wide ranges of rankings – explore with stakeholders to either elevate or de-emphasize

Consistently Low Ranking for all Stakeholders: Avoid these in portfolios

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Develop Portfolios (Exploratory, for comparison)

Themes to be developed with Steering Committee

Portfolio 1
Internal to Region

Project	Average Rank	Cost ($M)	Water Benefit (mgd)
UAW	2.4	$40	20%
Centralized PFAS	3.8	$80	40%
60 gpcd incentives	4.6	$10	10%
Efficiency measures	8.3	$12	15%
Inter-connections	9.8	$28	15%
TOTAL:		**$170**	**100%**

Portfolio 2
Internal and External

Project	Average Rank	Cost ($M)	Water Benefit (mgd)
UAW	2.4	$40	20%
Desal at 80%	3.0	$80	60%
MWRA abutting Weymouth	3.6	$20	15%
Efficiency measures	8.3	$12	15%
TOTAL:		**$152**	**110%**

Portfolio 3
Least Cost

Project	Average Rank	Cost ($M)	Water Benefit (mgd)
TOTAL:		**$170**	**100%**

Examples

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Water Supply Alternatives Discussion

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Water Supply Discussion

1. What are you committed to right now and in the next 5 years?

3. Longer term, do you feel there is a need for redundancy for drought, cyber security, short term issues or other concerns? Are you open to the following:

   a) MWRA

   b) Desalination

   c) Municipal Interconnections

   d) Reclaimed Water for Non-Potable Use (eg golf courses…)

   e) Other

4. What are actions that your organization would like to see included in the Regional Water Plan?

   As you answer these questions, consider local and regional resiliency.

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Next Workshop

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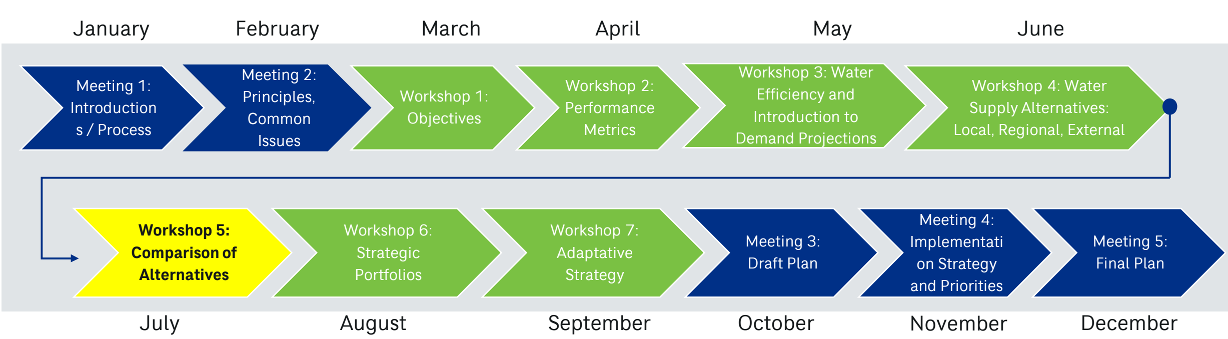
Next Workshop



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Upcoming Schedule

WHEN	DETAILS
Wednesday July 31st 9:00 am – 12:00 pm	Workshop 5
Tuesday, August 27th 9:00 am – 12:00 pm	Workshop 6
Tuesday, September 24th 9:00 am – 12:00 pm	Workshop 7
Tuesday, October 29th 9:00 am – 12:00 pm	Meeting 3
Monday, November 18th 8:00 am – 12:00 pm	Meeting 4
Tuesday, December 10th 8:00 am – 12:00 pm	Meeting 5

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Steering Committee Homework

- Annotated Bibliography
  - Final comments due 6/28/2024 to rozyckikm@cdmsmith.com via email.
- Scoring objectives and updated metrics
  - Feedback due by 7/12 rozyckikm@cdmsmith.com
- Demand Projections and Capacity Memo (by municipality)
  - Will be sent via email by end of this week
  - Feedback due by 7/12 rozyckikm@cdmsmith.com
- Interviews
  - Email Kyle Olsen at RVA (kolsen@reginavilla.com) if you have not yet scheduled your interview.

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Feedback Survey

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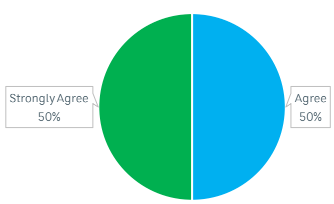
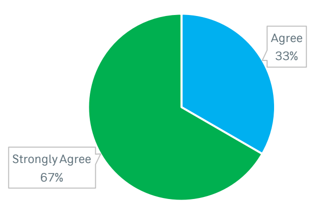
Last Meeting: Feedback Survey Results

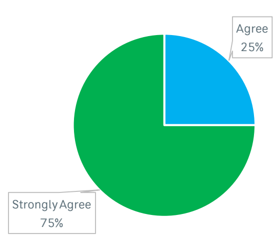
The meeting had a clear agenda.



Facilitation of today's meeting was effective.



I had plenty of opportunity to participate in the discussion today.



Legend
- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

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Appendix F
Steering Committee Workshop 5
07-31-2024

OLD COLONY
PLANNING COUNCIL

Rebecca Coletta, President	Mary Waldron, Executive Director

(508) 583-1833 | 70 School Street, Brockton, MA 02301 | www.oldcolonyplanning.org

Regional Water Plan
Steering Committee Meeting
MINUTES OF THE MEETING
Wednesday, July 31, 2024, 9:00am

Location: Old Colony Planning Council, 70 School St, Brockton, MA 02301

Attendees:

Steering Committee	
Organization	**Name**
Town of Abington	Liz Shea
Town of Avon	Jonathan Beder
Town of Bridgewater	Shane O’Brien
East Bridgewater	John Haines
Easton Department of Public Works	Greg Swan
Town of Kingston	Val Massard (via Zoom)
MA Department of Conservation and Recreation	Jason Duff
MassDEP	Duane LeVangie
MassDEP	Jon Hobill (via Zoom)
Pembroke Water Department	Dan Sullivan
OCPC	Joanne Zygmunt
Town of Plympton	Gavin Murphy (via Zoom)
Town of Plympton	Brian Vasa
Town of Plymouth	Kendra Martin
Watershed Associations	Pine duBois
Watershed Associations	Jimmy Powell (via Zoom)
Town of West Bridgewater	Wayne Parks
Whitman	Davis Lemay

Observers	
Organization	**Name**
OCPC	George
Cape Cod Cranberry Growers' Association	Brian Wick
EPA	Margherita Prior
MA Division of Marine Fisheries	John Sheppard
Jones River Landing and Historical Society	Mark Guidoboni

Consultants	
Organization	**Name**
CDM Smith	Grace Houghton
CDM Smith	Kirk Westphal
CDM Smith	Amara Regehr
CDM Smith	Grace Inman
CDM Smith	Kara Rozycki (via Zoom)

Minutes:

1) Call to Order, introductions

2) Public Comment – none

3) Demand Projections Review

    a) Refresher on CDM Smith Demand Projection and Efficiency Standards

        i) A reminder was provided that climate projections are used in analysis and monthly ranges will be provided to communities in community specific demand memorandums.

        ii) A reminder was provided that demand decreases over time are not due to active conservation but passive conservation due to changes in state regulation.

4) Long Term Local and Regional Alternatives (see handout)

    i) MWRA water

        (1) Concern about feasibility for MWRA to service all OCPC communities (i.e West Bridgewater) but worthwhile keeping as an alternative.

    ii) Water from Aquaria Desalination Plant

        (1) Discussion of the challenges of operating a desalination plant such as discharge limits and limited pumping during some periods due to fish migration.

        (2) Meeting participant brought up that Brockton purchasing the plant might be the most cost-effective option because they have higher principal forgiveness.

        (3) New suggestions included building a new desalination plant or having the State or County purchases existing plant.

(4) Mayor Robert Sullivan of Brockton stopped by the meeting with DPW Commissioner Pat Hill to discuss Brockton's position. Brockton currently does not know what future will be of the Aquaria Desalination Plant but is open and willing to work with all neighboring communities and MassDEP to find the best path forward. Mayor Sullivan mentioned that the previous Mayor had begun negotiations for the City to purchase the plant, but price was raised and discussions stopped.

iii) Interconnections and Inter-Municipal Agreements (IMA)

(1) Meeting participant brought up recommendation that the final report could include or recommend standardized language for IMA contracts.

b) Develop a Regional Plan for Stormwater Recharge

i) Consensus that that stormwater issues were better handled on a local level and not through a regional master plan.

c) Identification and Removal of Migratory Obstacles

d) New Wells

i) All towns except for Plympton and Whitman should be included in this alternative.

ii) Question on whether this alternative should distinguish between new wells and replacement wells?

e) Access to Clean Water for Private Well Owners through connection to Public Water Supply

i) Discussion on increasing number of residents connecting to public supply as private wells become contaminated.

ii) Question on whether the cost of individual PFAS filters would be greater than the cost of connecting to public supply?

5) Short Term Local and Regional Alternatives

a) Local Demand Management Alternatives were inspired by recommendations from Alliance for Water Efficiency.

i) Discussion of customer-side leak detection devices, resources, and education.

ii) MA grant to help fund rate studies: https://www.mass.gov/info-details/water-management-act-grant-programs-for-public-water-suppliers#statewide-water-management-act-grant-

b) Regional Demand Management Alternatives

i) Discussion of adding bylaws or workforce education to encourage native landscaping.

ii) Private well use restrictions fall under Board of Health jurisdictions.

c) Supply Management Alternatives

i) Plymouth and Hanson asked to be added to new public wells short-term alternative.

d) Environmental Alternatives (see handout)

6) Public Outreach Update

a) Environmental Roundtable in the afternoon 7/31/2024

Action Items:

Assigned to	Action Item
Steering Committee members	Complete weighting worksheet on behalf of your community/organization
CDM Smith	Provide communities with demand Projections and Capacity Memo (by municipality)
CDM Smith	Update the list of alternatives to reflect discussion from this workshop

Attachments:

1. Meeting Presentation Slides
2. Meeting Handouts

Prepared by CDM Smith.

Old Colony Planning Council Regional Water Plan

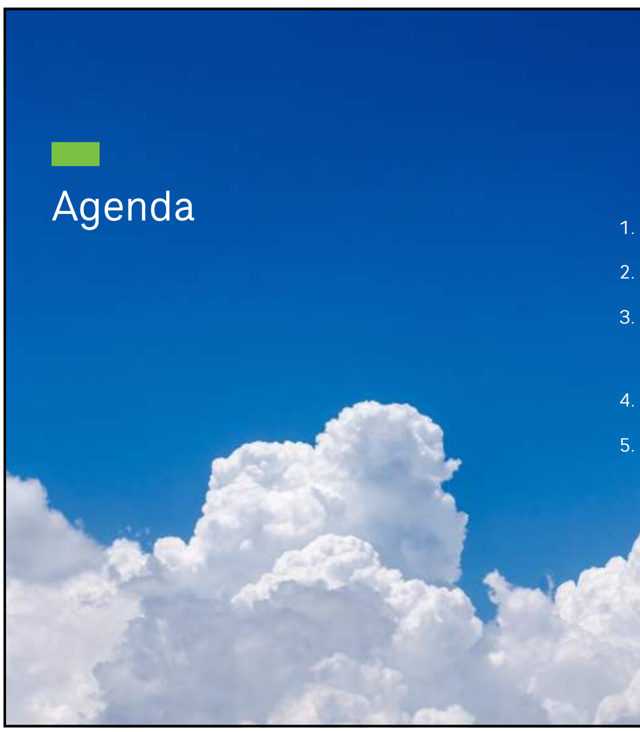
Workshop 5

Economic Resilience and Sustainable Water Supply

Kirk Westphal, Kara Rozycki, Tarun Gill, and Amara Regehr

July 31, 2024

1



Agenda

1. Public Comment
2. Demand Projections Review
3. Long Term Local and Regional Alternatives
   - Coffee Break
4. Short Term Local and Regional Alternatives
5. Public Outreach Update

OCPC Regional Water Plan 2

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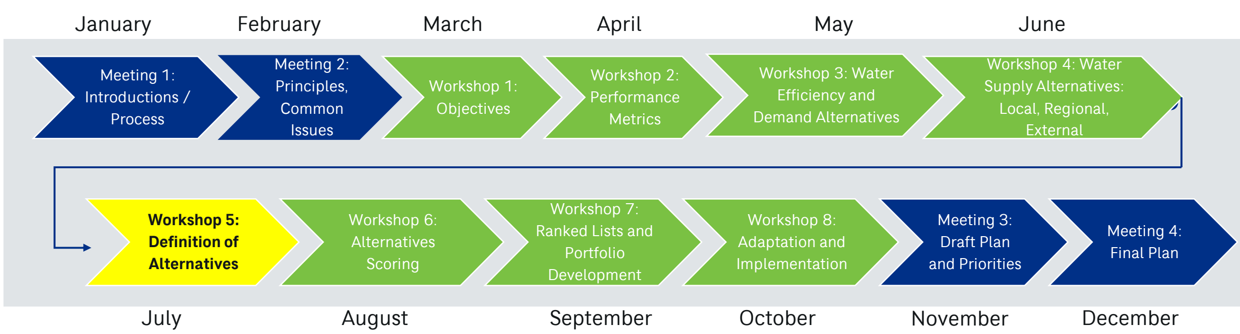
Public Comment

3

Overview of Regional Water Plan Process



OCPC Regional Water Plan 4

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Demand Projections Review

5

Future Scenarios for Planning

Planning Scenario	Population Growth	Future Climate Change	Water Use Efficiency	Trend in UAW	Private Wells to Public Supply
1. **Baseline**	Expected	Historical Average	Average increase in efficiency	Historical Average	None
2. **Low Stress**	Expected	Cool/Wet	Greater than average increase	Decrease	None
3. **Significant Stress**	10% greater than expected	Hot/Dry	Less than average increase	Increase	100%*
4. **Significant Stress with Mitigation**	10% greater than expected	Hot/Dry	Greater than average increase	Decrease	100%*

*100% of private wells from publicly available data. Not a comprehensive list.

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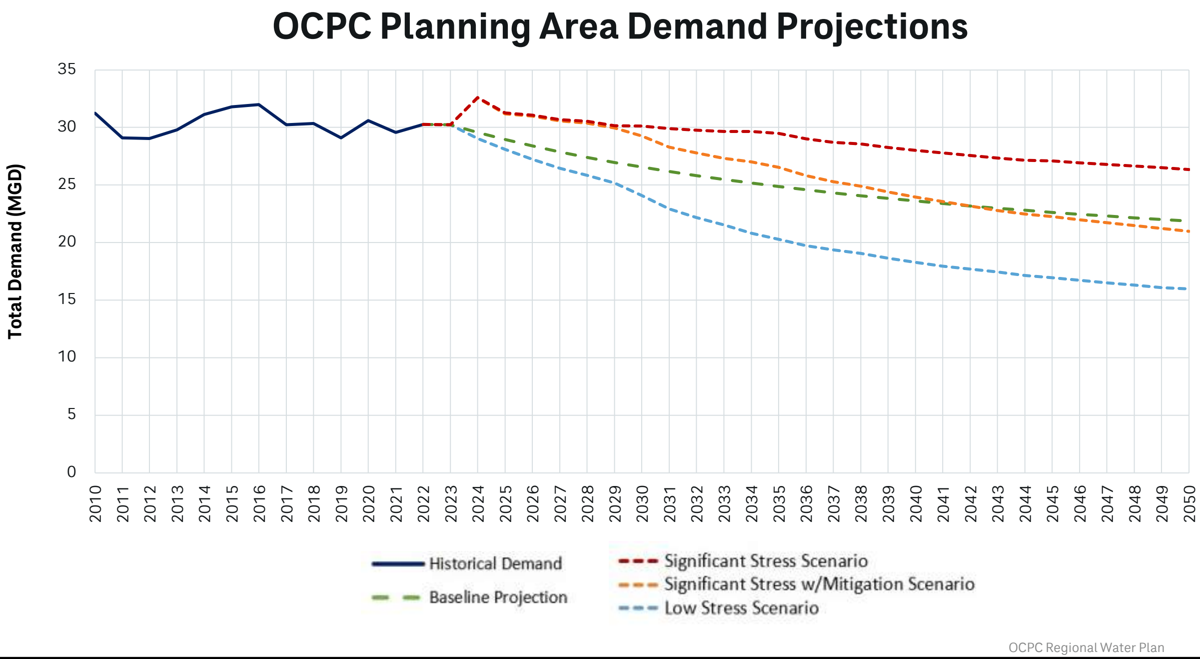

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Indoor Water Use Efficiency Index: Passive Conservation

- **Massachusetts Efficiency Standards**
  - Enacted Jan 1, 2023. Applies to faucets, showerheads, and toilets sold in Massachusetts
  - More stringent than existing Federal standards, results in 22.5% reduction for those end uses
- **Department of Energy (DOE) Standards**
  - Applies to residential clothes washers sold in U.S.
  - Latest standard is approx. 45% more efficient for top loaders and 60% more efficient for front loaders compared to estimated efficiency in 2016*
- **Flume Water data**
  - Real world water use data for Boston metro area indicates current indoor use of 34 GPCD**
  - OCPC planning area indoor water use is estimated at approx. 46 GPCD, indicating reduction of 12 GPCD (-26%) is obtainable with available fixtures and appliances

*Based on *2016 Residential End Uses of Water* from Water Research Foundation (Project #4309)
**Available at: https://flumewater.com/water-index/

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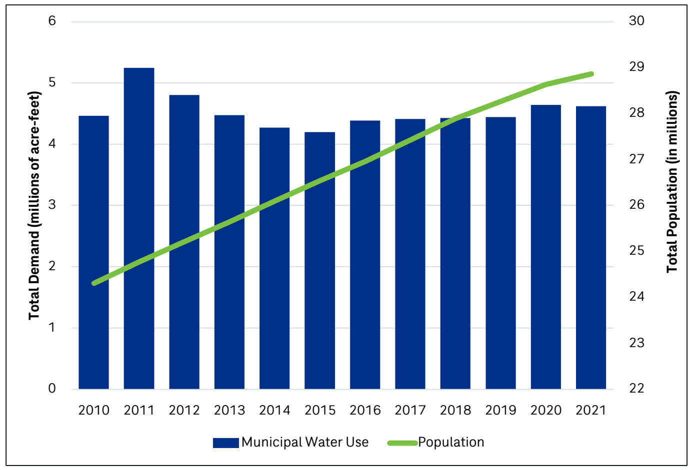
Impact of Passive Conservation on Total Demand

- Example from Texas
  - Total municipal use has been **relatively steady** between 2012 and 2021 **despite population increase** of 3.65 million (14.5%)
  - **Per capita** demand decreased 16% between 2012 and 2021
  - State efficiency standard implemented in **2014** more stringent than Federal standard



Sources: Texas Water Development Board and U.S. Census Bureau

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Long Term Local and Regional Alternatives

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Alternative definition

The potential **actions** that will be evaluated against **metrics**.

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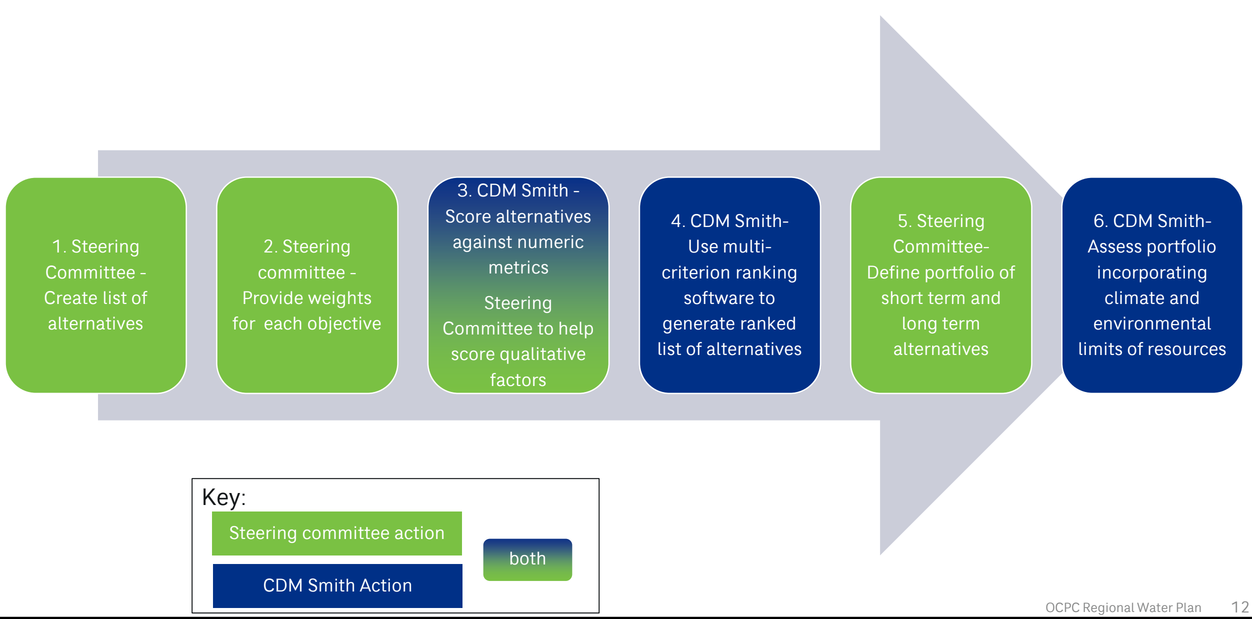
Upcoming steps for selection of alternatives



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Assessment of Alternatives (Step 3)

Steering Committee Framework

- Reliable Municipal Supply
- Ecological Health
- Cost effectiveness
- Innovation
- Fairness
- Drinking Water Quality
- Efficiency and Adaptability

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Assessment of Alternatives (Step 3)

Risk Assessment

- Provides supply redundancy
- Reduces climate risk
- Reduces PFAS risk
- Improves ecological health
- Provides resilience to uncertain growth

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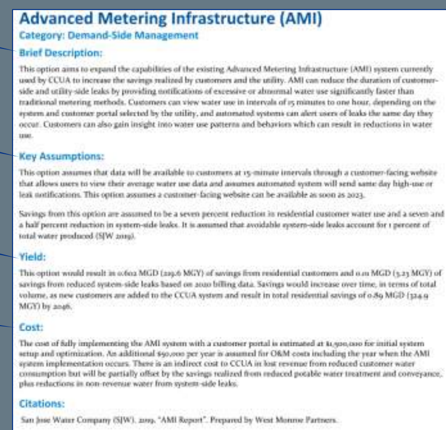
Future Further Development of Alternatives

- Description
- Assumptions
- Yield (Volume of water)
- High level cost
- Environmental impact or benefit
- Risk mitigation benefits

Example alternatives fact sheet



Advanced Metering Infrastructure (AMI)

Category: Demand-Side Management

Brief Description:

This option aims to expand the capabilities of the existing Advanced Metering Infrastructure (AMI) system currently used by CCUA to increase the savings realized by customers and the utility. AMI can reduce the duration of customer-side and utility-side leaks by providing notifications of excessive or abnormal water use significantly faster than traditional metering methods. Customers can view water use in intervals of 15 minutes to one hour, depending on the system and customer portal selected by the utility, and automated systems can alert users of leaks the same day they occur. Customers can also gain insight into water use patterns and behaviors which can result in reductions in water use.

Key Assumptions:

This option assumes that data will be available to customers at 15-minute intervals through a customer-facing website that allows users to view their average water use data and assumes automated system will send same day high-use or leak notifications. This option assumes a customer-facing website can be available as soon as 2023.

Savings from this option are assumed to be a seven percent reduction in residential customer water use and a seven and a half percent reduction in system-side leaks. It is assumed that avoidable system-side leaks account for 1 percent of total water produced (SJW 2019).

Yield:

This option would result in 0.602 MGD (219.6 MGY) of savings from residential customers and 0.01 MGD (5.23 MGY) of savings from reduced system-side leaks based on 2020 billing data. Savings would increase over time, in terms of total volume, as new customers are added to the CCUA system and result in total residential savings of 0.89 MGD (324.9 MGY) by 2046.

Cost:

The cost of fully implementing the AMI system with a customer portal is estimated at $1,500,000 for initial system setup and optimization. An additional $50,000 per year is assumed for O&M costs including the year when the AMI system implementation occurs. There is an indirect cost to CCUA in lost revenue from reduced customer water consumption but will be partially offset by the savings realized from reduced potable water treatment and conveyance, plus reductions in non-revenue water from system-side leaks.

Citations:

San Jose Water Company (SJW). 2019. "AMI Report". Prepared by West Monroe Partners.

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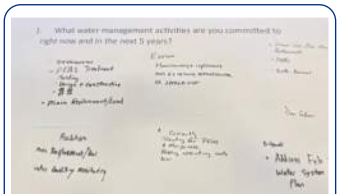
Formulation of alternatives



Poster activity from last workshop 1

Interviews 2

Recommendations from previous reports 3

TODAY: clearly define each alternative

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Categorization of alternatives

Local vs Regional

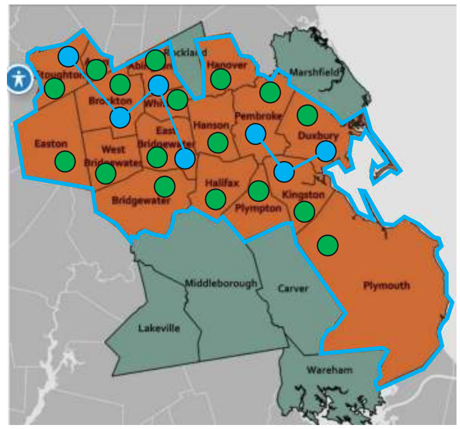
(Examples Only)

Timeline

2050

Next 5-10 years

Short Term → Long Term



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Long Term Regional Alternatives

Public Water Supply

- MWRA Water
- Water from Aquaria Desalination
- Interconnections and Inter-Municipal Agreements
- Reclaimed Water for Non-Potable Uses

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Public Water Supply Long Term Regional Alternatives

MWRA Water

1. Entire OCPC Region with Public Water Supply- all but Plympton
2. Communities Who Indicated Openness to MWRA- Abington, Avon, Bridgewater, Easton, Pembroke, Plympton, West Bridgewater
3. Communities Actively Exploring MWRA Connection- Abington, Avon, Hanover
4. Communities neighboring existing MWRA connection (Avon, Easton)

These are our ideas for MWRA configurations based off of what we have heard, are these the ones that you want to see analyzed?

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Public Water Supply Long Term Regional Alternatives

Water from Aquaria Desalination

1. Brockton purchases plant and provides water to interested communities: Abington, Avon, Bridgewater, Brockton, Easton, West Bridgewater
2. Brockton purchases plant and provides water to communities with existing connections: Abington, Avon, East Bridgewater, Halifax, Pembroke, Stoughton, Whitman
3. Brockton continues contract with Aquaria and develops cost model with other communities to share water and avoid other capital costs.
4. Joint purchase of plant

These are our ideas for desalination configurations, are these the ones that you want to see analyzed?

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Public Water Supply Long Term Regional Alternatives

Interconnections and Inter-Municipal Agreements

For Abington, Bridgewater, Easton, East Bridgewater, Plympton, Stoughton, West Bridgewater, Avon

Public Water Supply Long Term Regional Alternatives

Reclaimed Water for Non-Potable Uses

Bridgewater, Easton, Kingston, West Bridgewater, Agriculture Uses

Environmental Long Term Regional Alternatives

Environmental

Develop a Regional Plan for Stormwater Recharge

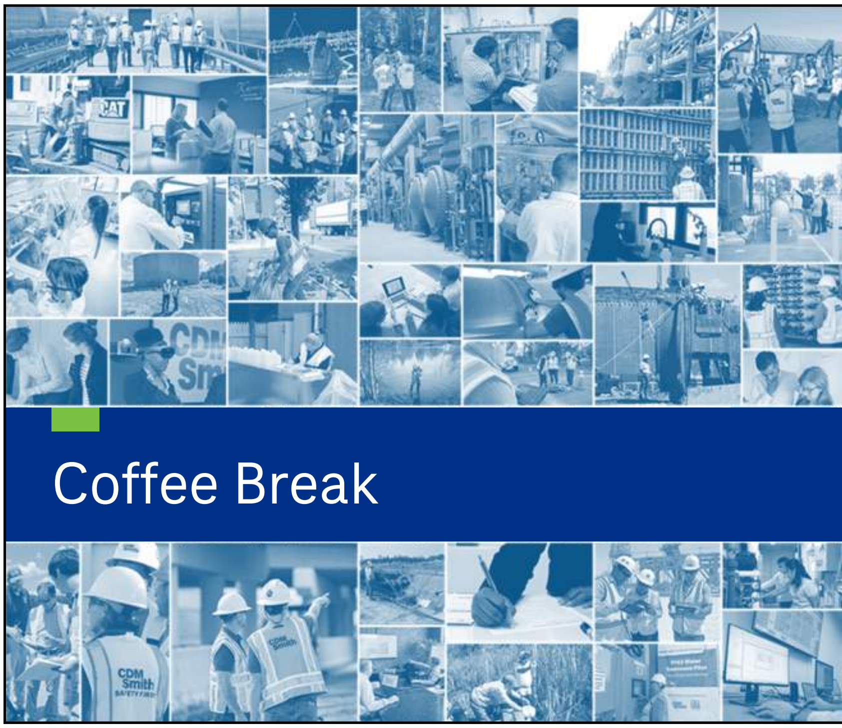
Identification and Removal of Migratory Obstructions

Long Term Local Alternatives

Public Water Supply

New Public Wells for Hanson, West Bridgewater, and Plympton

Access to Clean Water for Private Well Owners through Connection to Public Water Supply



Coffee Break

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Short Term Local and Regional Alternatives

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Short Term Local Alternatives

Demand Management

- Conduct, Validate, and Act on Annual AWWA Water Loss Audits
- Rebates for Leak Detection Devices for Customer-Side Leak Detection
- Advanced Metering Infrastructure
- Improve Increasing Block Rate Designs / Billing Intervals

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Short Term Local Alternatives

Supply

- Access To Clean Water For Private Well Owners – Education & Funding for in-home treatment/bottled water
- New Public Wells (Kingston, Bridgewater, Pembroke)
- Brockton to purchase and/or use aquaria desalination plant (Pave Way Toward Regional Use)
- Utilize Aquaria Desalination Water connections for communities with existing connections

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Short Term Local Alternatives

Environmental

Identify Reservoir Management Strategies

(ARJWW, Brockton)

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Short Term Regional Alternatives

Demand Management

- Support Agricultural Demand Side Management
- Native Landscaping
- Private Well Use Restrictions
- Conservation, Land, And Water Use Education Program
- Conservation Resource Center

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Short Term Regional Alternatives

Environmental

- Ecosystem Evaluation And Ecological Flow Needs
- Regional Conservation Committee: Coordinate Protection of Shared Resources

Other Recommendations

- Cybersecurity improvements
- Requirement for diversity/ redundancy of water sources in WMA permits

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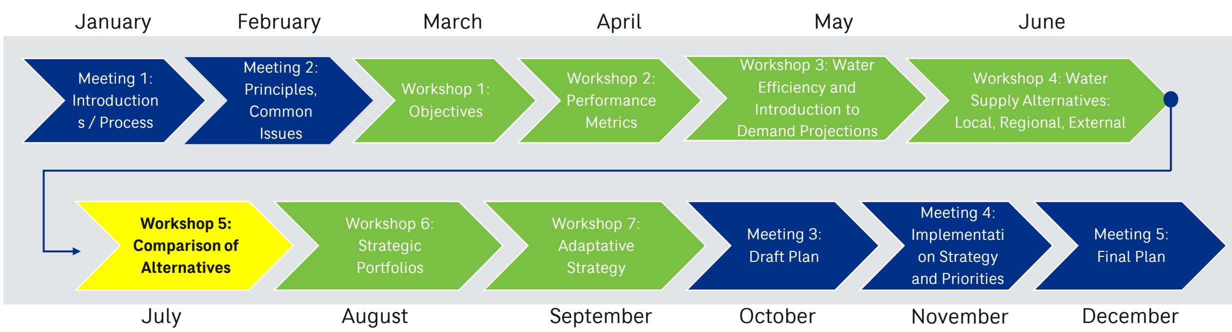
Next Workshop



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  - Feedback due by 8/7 rozyckikm@cdmsmith.com
- Demand Projections and Capacity Memo (by municipality)
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  - Feedback due by 8/14 rozyckikm@cdmsmith.com
- Interviews
  - Email Kyle Olsen at RVA (kolsen@reginavilla.com) if you have not yet scheduled your interview.

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Feedback Survey

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Relevance to Framework	Project Description	Communities/ Stakeholders to whom this could apply	Category	Notes
Long-Term Local Alternatives	Access to Clean Water for Private Well Owners - Connection to Public Water Supply	All	Supply	Kingston currently has a moratorium on new connections
	New Public Wells	Hanson, West Bridgewater, Plympton	Supply	Includes communities not actively pursuing development of new wells but those who have expressed interest in development of new public wells in the long term in previous reports or in interviews.
Long-Term Regional Alternatives	MWRA For Entire OCPC Region with Public Water Supply	Abington, Avon, Bridgewater, Brockton, Duxbury, East Bridgewater, Easton, Halifax, Hanover, Kingston, Pembroke, Plymouth, Stoughton, West Bridgewater, Whitman	Supply	Includes all communities but Plympton.
	MWRA For Communities Who Indicated Openness to MWRA	Abington, Avon, Bridgewater, Easton, Pembroke, Plympton, West Bridgewater	Supply	Includes communities who indicated openness to considering this as a water supply at the last workshop or in interviews.
	MWRA For Communities Actively Exploring MWRA Connection	Abington, Avon, Hanover	Supply	Includes communities who are actively pursuing MWRA connection studies or have previously conducted these studies.
	MWRA for Communities Bordering Existing MWRA Connection (Stoughton)	Avon, Easton	Supply	Avon and Easton border Stoughton which has an existing MWRA connection.
	Aquaria Desalination Under Brockton Ownership For Communities Open To Considering	Abington, Avon, Bridgewater, Brockton, Easton, West Bridgewater	Supply	Includes communities who indicated openness to considering this as a water supply at the last workshop or in interviews.
	Aquaria Desalination Under Brockton Ownership For Communities with Existing Connections	Abington, Avon, Bridgewater, Brockton, Easton, West Bridgewater	Supply	Includes communities with existing connections
	Aquaria Desalination Continues Under Private Ownership with Brockton Supplying Water For Communities Open To Considering	Abington, Avon, Bridgewater, Brockton, Easton, West Bridgewater	Supply	Includes communities who indicated openness to considering this as a water supply at the last workshop or in interviews.
	Aquaria Desalination Under Regional Ownership For Communities Open To Considering	Abington, Avon, Bridgewater, Brockton, Easton, West Bridgewater	Supply	Includes communities who indicated openness to considering this as a water supply at the last workshop or in interviews.
	Expand and/or Rehabilitate Interconnections with Inter-Municipal Agreements	Abington, Plympton, Easton, East Bridgewater, Bridgewater, West Bridgewater, Stoughton	Supply	Includes communities who indicated openness to considering this as an alternative at the last workshop or in interviews.

Relevance to Framework	Project Description	Communities/ Stakeholders to whom this could apply	Category	Notes
Long-Term Regional Alternatives	Reclaimed Water for Non-Potable Uses	Bridgewater, Easton, Kingston, West Bridgewater, Agriculture Uses	Demand	Includes communities who indicated openness to considering reclaimed water for non-potable uses at the last workshop.
	Develop a Regional Plan for Stormwater Recharge	All	Demand, Environmental	Particular benefit for communities who are reliant on groundwater for public water supply:
	Identification and Removal of Migratory Obstructions	Jones River Watershed Association and Taunton River Watershed Association	Environmental	Previous studies have been completed for removal of forges dam in the Jones River watershed. These will be used to help develop alternatives.
	Redundant Water Supply For Agriculture	Agricultural users	Supply	Provide additional water to agriculture users during periods of drought to support resilient farms. This could be through drilling new wells or connection to public water supply.
	Regional PFAS Treatment	All but Plympton	Supply	Includes all communities but Plympton.
Short Term Local Alternatives	Conduct, Validate, and Act on Annual AWWA Water Loss Audits	All	Demand , Maintenance	One regional action that may be included in the final report related to this would be securing funding for a regional training for conducting AWWA water loss audits.
	Rebates for Leak Detection Devices for Customer-Side Leak Detection	All	Demand	More details on detection devices are included in Alliance for Water Efficiency's memorandum titled *Recommendations for Water Efficiency in the Old Colony Planning Council's Region*. Examples of products include Droplet by Hydrific, Flume, and Flo by Moen.
	Advanced Metering Infrastructure	All	Demand	More information for demand management strategies that can be implemented following AMI, including customer facing portals and leak notification programs, is included in the Alliance for Water Efficiency memorandum on water conservation in the OCPC region.
	Improve Increasing Block Rate Designs	Abington, East Bridgewater, Halifax, Whitman	Demand	Kingston is currently working internally on updating block rates.
	Access To Clean Water For Private Well Owners - Education and Funding Assistance	All	Supply	Towns, potentially through Boards of Health, provide support for private well owners to understand the need for point source treatment and potentially provide information on existing grants for financial assistance to implement treatment.

Relevance to Framework	Project Description	Communities/ Stakeholders to whom this could apply	Category	Notes
Short-Term Local Alternatives	Identify Reservoir Management Strategies	Abington, Brockton	Supply, Environmental	This alternative includes communities in OCPC region that have a reservoir. This alternative would have to be considered depending on the additional water supply alternatives.
	New Public Wells	Bridgewater, Pembroke, Kingston	Supply	Includes communities actively pursuing development of new wells. New wells expected online within next 5-10 years.
	Brockton to purchase and/or use aquaria desalination plant (Pave Way Toward Regional Use)	Brockton	Supply	Local alternative to pave way for regional use.
	Utilize Aquaria Desalination Water connections for communities with existing connections	Abington, Brockton	Supply	Abington and Brockton have existing connections to desalination plant.
Short-Term Regional Alternatives	Support Agricultural Demand Side Management (research grants)	Agricultural users	Demand	Identify practices and potential funding support for agricultural demand side management practices.
	Ecosystem Evaluation And Ecological Flow Needs	All	Environmental	Goal of establishing minimum flow needs for healthy streams and wetlands. Could focus on site-specific ecology for a water bodie(s) of interest in region.
	Native Landscaping	All	Demand	More use of native landscaping, with need for workforce development with landscapers
	Private Well Use Restrictions	Most	Demand	Limit private well irrigation during droughts. Could be through a mandate from Boards of Health.

Relevance to Framework	Project Description	Communities/ Stakeholders to whom this could apply	Category	Notes
Short-Term Regional Alternatives	Conservation, Land, And Water Use Education Program	All	Demand	Programs for public education
	Regional Conservation Committee: Coordinate Protection of Shared Resources	All	Environmental	
	Conservation Resource Center	All	Demand	Resource center to reduce consumption. Should this be geared towards public utilities.
	Cybersecurity Improvements	All	Maintenance	Could be regional training or resource center

Appendix F
Steering Committee Workshop 6
08-27-2024

OLD COLONY
PLANNING COUNCIL

Rebecca Coletta, President	Mary Waldron, Executive Director

(508) 583-1833	70 School Street, Brockton, MA 02301	www.oldcolonyplanning.org

Regional Water Plan
Steering Committee Meeting
MINUTES OF THE MEETING
Tuesday, August 27, 2024, 9:00am

Location: Old Colony Planning Council, 70 School St, Brockton, MA 02301

Attendees:

Steering Committee	
Organization	**Name**
Town of Bridgewater	Shane O'Brien
City of Brockton	Pat Hill
Central Plymouth County Water District	Kimberly Groff
Easton Department of Public Works	Greg Swan
Town of Kingston Water Commission	Bob Erlandsen
Town of Kingston	Keith Hickey
Town of Kingston	Val Massard (via Zoom)
MA Department of Conservation and Recreation	Jason Duff
MassDEP	Duane LeVangie
MassDEP	Jon Hobill (via Zoom)
Pembroke Water Department	Dan Sullivan
OCPC	Bill Napolitano
OCPC	Joanne Zygmunt
Town of Plympton	Gavin Murphy (via Zoom)
Town of Plymouth	Peter Gordon
Watershed Associations	Pine duBois
Watershed Associations	Jimmy Powell (via Zoom)

Observers	
Organization	**Name**
MA Division of Marine Fisheries	John Sheppard
Metropolitan Area Planning Council	Martin Pillsbury

Consultants	
Organization	**Name**
CDM Smith	Grace Houghton
CDM Smith	Kirk Westphal
CDM Smith	Amara Regehr
CDM Smith	Grace Inman
CDM Smith	Kara Rozycki

Minutes:

1) Call to Order, introductions
    a) Reminder: Steering Committee Score Sheets due Tuesday 9/3/2024.
2) Public Comment – none
3) Upcoming Climate Risk Assessment
    a) Incorporating future climate risks into Regional Plan
    b) Dr. Casey Brown advising on climate aspect of demand analysis, models, drought tool, and risk assessment for alternatives
    c) Identification of hazards, including heavier rainfall, extreme heat and how these interact with the Regional Plan
    d) Regional Stormwater discussion – recommendations around this are requested
    e) Mosquito treatment – recommendations around this topic are requested
    f) Saltwater intrusion – Plymouth has not seen impact to municipal wells, but this could become a serious issue in the future. Private wells closer to the coast are at higher risk.
4) Water Supply Augmentation Discussion
    a) Meeting with each community today to identify water supply target to use for alternatives analysis. Could be a buffer on operational capacity, could be what portion of your supply is at risk from PFAS, or another constraint in community requiring additional volume. That volume will be used to cost and score.
5) Qualitative Scoring Activity
    a) Reviewed updates to alternatives
    b) Projects were identified to be included in report as recommendations, so they will not be scored: Native Landscaping (include climate resistant options), Private Well Restrictions, Conservation, Land, and Water Use Education Programs, Regional Conservation Committee (request to expand to include education), Conservation Resource Center, Cybersecurity Improvements, Stormwater Recharge Regional Plan. Steering Committee agreed to include these as Report Recommendations
    c) Review of Short-Term Alternative ST-11: Ecosystem evaluation and ecological flow needs (Taunton River Watershed, Jones River, Silver Lake, Stump Brook). Steering Committee agreed to include this as a Report Recommendation and to not include as an alternative.

d) Split into three groups to rate alternatives for two qualitative alternatives and begin considering risk and uncertainty for each alternative.
    i) Improve ecosystem health
    ii) Encourage sustainable water use to meet the needs for housing and economic prosperity
    iii) Overall Risk Assessment

6) Qualitative Scoring Activity Report Out

    a) Ecosystem Health Objective
        i) Scores based on aggregate positive / negative impacts
        ii) Public wells – medium to higher scores
        iii) Long Term Regional Alternatives – higher scores, with the exception of LT11 (Expand and/or Rehabilitate Interconnections with Inter-Municipal Agreements) and LT12 (Reclaimed Water for Non-Potable Uses)
        iv) Short Term Local alternatives – higher scores, with the exception of ST5 (Access to Clean Water For Private Well Owners – Education and Funding Assistance) and ST7 (New Public Wells)
        v) Short Term Regional Alternatives – higher scores
    b) Efficiency & Adaptability Objective
        i) New wells, MWRA, and Aquaria were generally low score due to high difficulty for implementation, but high score for flexibility because of the increase in water that would be provided
        ii) Group identified a few alternatives that are recommended to move to the Recommendation List versus scored alternatives (ST6 (Identify Reservoir Management Strategies), LT13 (Identification and Removal of Migratory Obstructions), ST11 (Ecosystem Evaluation and Ecological Flow Needs))
        iii) Group recommended removing ST9 (Utilize Aquaria Desalination Water connections for communities with existing connections) due to redundancy, since Abington does not have a direct connection to the desalination plant
    c) Overall Risk Assessment
        i) Always risks for every alternative, even those with substantial benefits
        ii) Time and money are consistently risks
        iii) Sacrificing what you have worked so hard for already
        iv) Unintended consequences
        v) Regionalization concern about chemical compatibility of water

    d) CDM Smith will combine scores from all three groups, and Steering Committee will have opportunity to review all scores and provide additional comments.

7) Next Workshop: 9/24

Action Items:

Assigned to	Action Item
Steering Committee members	Complete weighting worksheet on behalf of your community/organization

Attachments:

1. Meeting Presentation Slides
2. Meeting Handouts

Prepared by CDM Smith.

Appendix F
Steering Committee Workshop 7
09-24-2024

OLD COLONY
PLANNING COUNCIL

Rebecca Coletta, President	Mary Waldron, Executive Director

(508) 583-1833	70 School Street, Brockton, MA 02301	www.oldcolonyplanning.org

Regional Water Plan
Steering Committee Meeting
MINUTES OF THE MEETING
Tuesday, September 24, 2024, 9:00am

Location: Old Colony Planning Council, 70 School St, Brockton, MA 02301

Attendees:

Steering Committee	
Organization	**Name**
Town of Abington	Liz Shea
Town of Bridgewater	Shane O'Brien
Town of Bridgewater	John Haines
City of Brockton	Pat Hill
Central Plymouth County Water District	Kimberly Groff
Easton Department of Public Works	Greg Swan
Town of Kingston Water Commission	Bob Erlandsen
Town of Kingston	Val Massard (via Zoom)
MA Department of Conservation and Recreation	Jason Duff
MassDEP	Duane LeVangie
MassDEP	Jon Hobill (via Zoom)
Pembroke Water Department	Dan Sullivan
OCPC	Bill Napolitano (via Zoom)
OCPC	Mary Waldron
OCPC	Joanne Zygmunt
Town of Plympton	Gavin Murphy (via Zoom)
Town of Plympton	Brian Vasa (via Zoom)
Town of Plymouth	Kendra Martin
Town of West Bridgewater	Wayne Parks
Watershed Associations	Pine duBois
Watershed Associations	Jimmy Powell (via Zoom)

Observers	
Organization	**Name**
MA Division of Marine Fisheries	John Sheppard (via Zoom)
MA Cranberries	Brian Wick (via Zoom)

Consultants	
Organization	**Name**
CDM Smith	Grace Houghton
CDM Smith	Kirk Westphal
CDM Smith	Amara Regehr
CDM Smith	Grace Inman
CDM Smith	Dan Rodrigo
CDM Smith	Kara Rozycki
UMass Amherst	Dr. Casey Brown

Minutes:

1) Call to Order, introductions

2) Public Comment – none

3) Prioritization Background Information

    a) Review of alternative changes made

    b) Review of objectives and metrics

    c) Review of example alternative scoring for Alternative LT-2 – New Public Wells

    d) Review of alternatives against each metric

    e) Discussion

        i) Distribution of weighting by stakeholders – water suppliers make up majority of steering committee, therefore drinking water quality was weighted highest. Sensitivity analyses to be discussed later in meeting and results from running with equal weighting across all objectives.

        ii) Direct relationship between scoring and costs. Concerned for this to lower environmental scoring.

        iii) LT-10 – Includes PFAS removal through the desalination process.

        iv) Reminder of projects that are recommendations, and not being scored.

4) Summary of Ranking Results and Initial Steps in Portfolio Development

    a) Review of Weighted Results

i) Discussion

(1) Risk Assessment to be presented at next Workshop 8

(2) Private Well Connections – questions regarding reliability

(3) MWRA for all – Drinking Water Quality does not score because it could not come on quickly enough to meet 2029 PFAS regulations. Discussion of separating out short term and long term water quality goal through adding another qualitative metric for this objective.

ii) Review of results using equal rates

iii) Sensitivity Bar Graph emphasizing Ecosystem Health Objective

iv) Sensitivity Bar Graph emphasizing Cost Effectiveness

v) Sensitivity Bar Graph removing Cost Effectiveness

vi) Sensitivity to Stakeholder Weights

vii) Discussion of MWRA for Adjacent Communities- agreed that this could come online to avoid local PFAS communities for communities neighboring Stoughton's exiting MWRA connection

viii) Consider combining target supplies over 20 MGD into one category instead of specifying values over 20 MGD

ix) Update Water Quality Metric Scoring: short term (quantitative 1-3) and long term (qualitative 1-3)

x) Discussion around uncertainty with demand projections declining due to state housing policies including Additional Dwelling Units, and MBTA communities regulation

xi) Uncertainty of DEP approving interbasin transfer associated with MWRA alternatives

5) UMass Supporting Climate Risk Assessment

a) Introduction by Dr. Casey Brown

b) Discussion of uncertainty of climate change

c) Modelling future conditions uses three different pillars: theory, model, historical observations – looking to where they line up

d) Casey will be supporting on risk assessment

e) Variability of events? Observationally, flood trends of actual events– no clear signal of worsening. Models may suggest otherwise. In Northeast, seeing increasing intensity of storms, at rate faster than other parts of country. Consistent theory that it may be tied to climate change. Drought is less clear.

f) Climate migration effects on population?

g) Variability between dry and wet periods? Short term events need to have long term impact over time to achieve statistical significance.

h) How will climate uncertainty be incorporated into the Final Plan? As part of the Risk Assessment, and hydrologic assessment for the Taunton and South Coastal watersheds.

6) Next Workshop: 10/29

a) Portfolio Development, Adaptation, Implementation

Action Items:

Assigned to	Action Item
CDM Smith	Update scoring of alternatives to include updated metric for long term water quality
All	Support sharing of survey

Attachments:

1. Meeting Presentation Slides
2. Meeting Handouts

Prepared by CDM Smith.

Appendix F
Steering Committee Workshop 8
10-29-2024

OLD COLONY
PLANNING COUNCIL

Rebecca Coletta, President	Mary Waldron, Executive Director

(508) 583-1833 | 70 School Street, Brockton, MA 02301 | www.oldcolonyplanning.org

Regional Water Plan
Steering Committee Meeting
MINUTES OF THE MEETING
Tuesday, October 29, 2024, 9:00am

Location: Old Colony Planning Council, 70 School St, Brockton, MA 02301

Attendees:

Steering Committee	
Organization	**Name**
Town of Abington	Liz Shea
Town of Avon	Jon Beder
Town of Bridgewater	Shane O'Brien
City of Brockton	Pat Hill
Easton Department of Public Works	Greg Swan
Town of Kingston	Val Massard (via Zoom)
MA Department of Conservation and Recreation	Jason Duff
OCPC	Becky Coletta
OCPC	Bill Napolitano
OCPC	Mary Waldron
OCPC	Joanne Zygmunt
Town of Pembroke	Dan Sullivan
Town of Plympton	Gavin Murphy (via Zoom)
Watershed Associations	Pine duBois
Watershed Associations	Jimmy Powell (via Zoom)

Observers	
Organization	**Name**
MA Division of Marine Fisheries	John Sheppard (via Zoom)
MA Cranberries	Brian Wick (via Zoom)

Consultants	
Organization	**Name**
CDM Smith	Grace Houghton
CDM Smith	Kirk Westphal
CDM Smith	Amara Regehr
CDM Smith	Grace Inman
CDM Smith	Kara Rozycki

Minutes:

1) Call to Order, introductions

2) Public Comment – none

3) Risk Considerations

    a) Risk matrix to be shared with Steering Committee

    b) Request to add definition/clarifying parameters for the risk categories

4) Updated Alternatives Scoring

    a) Review of updated scoring with water quality metric changes. Additional qualitative score added: "Reduction in Long-Term Water Quality Risk"

    b) Discussion of blending concern with MWRA water

    c) Alternatives memo will be distributed in coming weeks and will include more details on all of the alternatives.

5) Draft Portfolio Presentation

    a) Review of Draft Short-Term Portfolio (5 years)

    b) Review of Draft Long-Term Portfolio (over 5 years)

    c) Review of Draft Adaptive Management Plans

6) Discussion of Implementation of Best Practice Recommendations

    a) Review of list of recommendations:

        i) Identification and Removal of Migratory Obstructions
        ii) Access To Clean Water for Private Well Owners - Education and Funding Assistance
        iii) Identification of Reservoir Management Strategies
        iv) Ecosystem Evaluation and Ecological Flow Needs
        v) Native Landscaping Local By-Laws
        vi) Private Well Outdoor Water Use Restrictions Local By-Laws
        vii) Requiring Water Quality Tests of Private Wells By-Laws
        viii) Water Demand Offset Policies
        ix) Water Use Mitigation Program

x) Conduct Regular Rate Studies
xi) Inter-Municipal Agreements
xii) Redundant Water Supply for Agriculture
xiii) Support Agricultural Demand Side Management
xiv) Conservation, Land, And Water Use Education Program
xv) Regional Conservation Committee: Coordinate Protection of Shared Resources
xvi) Conservation Resource Center
xvii) Cybersecurity Improvements
xviii) Regional Stormwater Plan
xix) Regional Wastewater Plan
xx) Regional Coordination for Local PFAS Treatment Implementation

b) Discussion:

i) Consider regional pursuit for bylaws with the state

ii) Standing Committee can work on items following completion of the Regional Plan

7) Report out on small group discussions

a) Group A

i) Identification and Removal of Migratory Obstructions

(1) Education for dam removal is required to better understand complexities, funding, and benefits.

(2) Update history of dams in fact sheet

ii) Access To Clean Water for Private Well Owners - Education and Funding Assistance

(1) Get together with Ipswich River group to understand how they are incorporating private well users into their plan

(2) Continually get the message out to private well users about testing and water quality importance

(3) Staffing is an issue for Boards of Health on private well user support

iii) Identification of Reservoir Management Strategies

iv) Water Demand Offset Policies

(1) Efficiency is a better term than Conservation for water users.

(2) Committee could help identify grant funding

b) Group B

i) Private Well Outdoor Water Use Restrictions Local By-Laws

(1) Likely not an appetite in Plympton. Remove Plympton.

(a) Consider Rocky Harvest Water Extraction/Rocky Mountain Spring Water which has an agricultural water use permit.

(2) Risks include compliance. How would you know who is on a well?

(3) Consider specifying for lawn watering (ie., not for vegetable gardens)

(4) Future committee can draft example bylaw and educational materials that are suitable across town lines. Coordination of consistent signage for droughts.

(5) Stakeholder coordination required: Water Departments, City Council, Select Boards, etc.

ii) Water Use Mitigation Program

(1) Water Neutral Development

(2) Add Acton as example community

(3) Applies to all as a long-term recommendation

(4) Risk: Could impact future development/attainable housing

iii) Inter-Municipal Agreements

(1) Future committee can draft example agreements as starting points for alternatives and recommendations from the Regional Water Plan

c) Group C

i) Ecosystem Evaluation and Ecological Flow Needs

(1) Need to incorporate other Town boards (Conservation Commission, Planning Board, etc.)

ii) Native Landscaping Local By-Laws

(1) Provide a list of plantings

(2) Need to incorporate other Town boards (Conservation Commission, Planning Board, etc.)

iii) Requiring Water Quality Tests of Private Wells By-Laws

(1) Likely coming as part of real estate transactions around the country.

(2) Public awareness will be needed

(3) Need to incorporate other Town boards (Conservation Commission, Planning Board, Board of Health, etc.)

iv) Conduct Regular Rate Studies

(1) Good practice for all water suppliers to complete approximately every 5 years. Funding available.

8) Next Steps

   a) Review of Schedule:

      i) Workshop 9: November 18, 2024

      ii) Draft Regional Plan issued to Steering Committee: January 2025

      iii) Public Comment Period: February 2025

      iv) Final Plan Issued: March 2025

Action Items:

Assigned to	Action Item
CDM Smith	Share Risk Matrix PDF
CDM Smith	Distribute Alternatives Memo
CDM Smith	Update fact sheets with Steering Committee comments
All	Support sharing of survey

Attachments:

1. Meeting Presentation Slides
2. Meeting Handouts

Prepared by CDM Smith.

Appendix F
Steering Committee Workshop 9
11-18-2024

Regional Water Plan
Steering Committee Meeting
MINUTES OF THE MEETING
Monday, November 18, 2024, 10:00am

Location: Virtual (Zoom)

Attendees:

Steering Committee	
Organization	**Name**
Town of Abington	Liz Shea
Town of Abington	Scott Lambiase
Town of Bridgewater	Shane O'Brien
Town of Bridgewater	Greg Tansey
City of Brockton	Pat Hill
CPC	Kim Groff
East Bridgewater	John Haines
Easton Department of Public Works	Greg Swan
Town of Kingston	Val Massard
Town of Kingston	Chris Veracka
MA Department of Conservation and Recreation	Jason Duff
OCPC	Mary Waldron
OCPC	Bill Napolitano
OCPC	Elise Prince
OCPC	Joanne Zygmunt
Town of Pembroke	Dan Sullivan
Town of Plympton	Gavin Murphy
Town of Plympton	Brian Vasa
Town of Plymouth	Peter Gordon
Watershed Associations	Pine duBois
Watershed Associations	Jimmy Powell

Observers	
Organization	**Name**
MA Division of Marine Fisheries	John Sheppard
MassDEP	Jon Hobill
MassDEP	Duane LeVangie
Senator Brady's Office	Al DeGirolamo

Consultants	
Organization	**Name**
CDM Smith	Grace Houghton
CDM Smith	Kirk Westphal
CDM Smith	Amara Regehr
CDM Smith	Grace Inman
CDM Smith	Kara Rozycki
CDM Smith	Dan Rodrigo

Minutes:

1. Introduction, Call to Order
2. Public Comment
    a. Matt Penella, Town of Kingston Conservation Agent, expressed concerns with draft rating results rating MWRA lower than other options. Concerned with two issues (1) ecological issues/degradation of Silver Lake and (2) safe drinking water to Brockton and its customers. Interested in seeing more diversification of water supplies.
3. Discussion on Regional Portfolios
    a. Abington discussed pursuing both desalination and MWRA sources
    b. Brockton management strategy is needed to manage water between Silver Lake, desalination, etc. More clarification is needed to better define.
    c. Plymouth has two sources in the Buzzards Bay Basin as well as the sources in the South Coastal
    d. Town of Plympton: Emergency well is more dependent on finding a suitable location and funding
    e. It is not clear how what is outlined will address ecological concerns
    f. How will these uses be monitored for compliance with the regional matrix of decisions that will protect surface waters
    g. MWRA connections should be projected soon as other south shore communities (Weymouth, Plymouth) are considering a connection.

h. Is desal an option for Easton?

i. Is Avon evaluating MWRA?

j. If Abington/Rockland becomes MWRA member, what becomes of their source in the Town of Pembroke?

k. Abington would pursue either desal or MWRA, whichever is available first and feasible

l. DCR will have grant available for water conservation soon. Notice of Intent is currently available.

m. OCPC can support on the Committee to continue the Regional Plan and support the recommendations

n. Regional and local pesticide needs

o. For Agricultural demand side management, consider impact on river flows/timing seasonality and impact on water quality

p. Packaging of recommendations requested so communities could work on bylaws/policies

q. Abington working with Rockland (and open to joining with other communities) on stormwater grant. OCPC has certified culvert inspector on staff.

r. Recommended to add to Best Practice Recommendations: Pesticide/Mosquito Management. Program needed to define the problem and manage mosquitos.

4. Discussion on Decision Points and Monitoring Data Collection

    a. New or changing regulations that could impact the supply and resource system

    b. Ability to meet demand or state requirements

    c. Ability to meet daily demand needs

    d. Additional regulation chemicals in the water

    e. Are we meeting demand and maintaining ecosystem? Are there changes in population or crashing environmental resources – whether water availability (drought) or vanishing fisheries. How is climate impacting regional/local resources – flooding, drought, disease, fire, greater consumption? Are we adapting and accommodating change or suffering?

    f. Discussion of environmental dashboard

    g. Monitoring data collection

        i. DMF has herring river count data

        ii. There are additional streamflow gauges

5. Next Steps

a. Draft Regional Plan issued to Steering Committee: January 2025

b. Public Comment Period: February 2025

c. Final Plan Issued: March 2025

Action Items:

Assigned to	Action Item
CDM Smith	Incorporate Steering Committee comments into portfolios
All	Support sharing of survey

Attachments:

1. Meeting Presentation Slides

Prepared by CDM Smith.

Appendix G Public Outreach Files: Postcard, Flyer, Website Info, Project Communications Plan, and Survey

Appendix G
Communications Plan

OCPC Regional Water Plan

COMMUNICATIONS PLAN

SUMMARY

To meet the stated goal of developing a Regional Water Plan, the team has developed a communications plan that:

1: Identifies key stakeholders that will be affected by and interested in the process.
2: Identifies key concerns and topics of interest for each stakeholder group.
3:Identifies specific communication strategies and ways to engage different stakeholder groups in the plan.

This plan details stakeholder engagement strategies designed to enhance participation and to better solicit meaningful feedback from targeted stakeholders and the wider general public. These strategies will support key public engagement activities, including public workshops, small group roundtables, and 1-on-1 stakeholder interviews.

Strategies will leverage digital, print, and in-person outreach as best to accomplish engagement goals.

OUTREACH GOALS

PUBLIC OUTREACH IS ESSENTIAL TO THE SUCCESS OF THIS PROJECT. ENSURING STAKEHOLDERS ARE INFORMED, ENGAGED, AND EDUCATED IS CRITICAL TO SMOOTHLY IMPLEMENTING A PLAN THAT WILL GUIDE THE WATER USE AND MANAGEMENT WITHIN THE OCPC AREA FOR THE COMING DECADES. FREQUENT AND TIMELY COMMUNICATION WILL HELP STAKEHOLDERS UNDERSTAND THE NEED FOR THIS PLAN AND ALLOW THEM TO ENGAGE EFFECTIVELY. TO ACHIEVE THESE GOALS, RVA WILL WORK WITH THE PROJECT TEAM TO:

- IDENTIFY KEY STAKEHOLDERS THAT WILL BE AFFECTED BY AND INTERESTED IN THE PROCESS.
- IDENTIFY KEY CONCERNS AND TOPICS OF INTEREST FOR EACH STAKEHOLDER GROUP.
- IDENTIFY SPECIFIC COMMUNICATION STRATEGIES AND WAYS TO ENGAGE DIFFERENT STAKEHOLDER GROUPS IN THE PLAN.

KEY ISSUES

FUTURE DEMAND

HOUSING;
ECONOMIC DEVELOPMENT

CLIMATE

RELIABILITY;
DROUGHT RISK;
SEA LEVEL RISE & SALTWATER INTRUSION IN GROUNDWATER

QUALITY

PFAS;
HARMFUL ALGAE BLOOMS;
STORMWATER QUALITY;
AQUATIC HABITAT;
REGULATORY COMPLIANCE

REGIONAL CONSIDERATIONS

EQUITY;
AFFORDABILITY;
BENEFITS

LOCAL ANGLES

CITY/TOWN SPECIFIC ISSUES;
ON-THE-GROUND BENEFITS

THESE ISSUES, IDENTIFIED EARLY BY THE PROJECT TEAM, WILL HELP GUIDE ENGAGEMENT AS BEST TO INFORM THE WATER PLAN.

PUBLIC ENGAGEMENT
ACTIVITIES

GOAL: PUBLICIZE THE PUBLIC WORKSHOPS AND GENERATE ATTENDANCE & ENGAGEMENT

MATERIAL/TASK	NOTES/TIMELINE
DEDICATED E-BLASTS	PROJECT TEAM TO AUTHOR TAILORED E-BLASTS TO DATABASE, EXISTING OCPC NEWSLETTER RECIPIENTS, AND STEERING COMMITTEE MEMBERS ENCOURAGING ATTENDANCE. (TWICE BEFORE MEETING)
WEBSITE UPDATES	PROJECT TEAM TO AUTHOR UPDATE ANNOUNCING MEETING INFORMATION (2-3 WEEKS PRIOR TO MEETINGS)
PRESS RELEASE/MEDIA OUTREACH	PROJECT TEAM WILL AUTHOR PRESS RELEASES THROUGH DIRECT CONTACT WITH LOCAL JOURNALISTS; COORDINATE WITH LOCAL CABLE ACCESS TV (AT LEAST 2 WEEKS PRIOR TO MEETING)
MATERIALS DISTRIBUTION	FLYERS AND POSTCARDS IN APPROPRIATE LANGUAGES TO BE DISTRIBUTED TO TARGETED COMMUNITY GATHERING SPOTS LIKE LIBRARIES, GROCERY STORES, CHURCHES (3 WEEKS PRIOR TO MEETING)
TARGETED OUTREACH	REACHING OUT DIRECTLY VIA EMAIL AND/OR PHONE TO IDENTIFIED STAKEHOLDERS (3 WEEKS PRIOR TO MEETING)
MEETING PARTICIPATION	ATTEND LOCAL CIVIC AND/OR ENVIRONMENTAL GROUP MEETINGS TO PUBLICIZE PUBLIC MEETINGS TO MEMBERS.
TABLE EVENTS	TABLE AT LOCAL EVENTS, SUCH AS PLYMOUTH FARMERS MARKET OR LITTLE LEAGUE OPENING DAY
PUBLIC TRANSPORTATION	GRASSROOTS ACTIVITY AT PUBLIC TRANSIT STOPS, INCLUDING LEAVING AND/OR DISTRIBUTING FLYERS
SOCIAL MEDIA	LEVERAGE EXISTING OCPC ACCOUNTS; COORDINATE WITH LOCAL GOVERNMENTS AND COMMUNITY ORGANIZATIONS TO HAVE MATERIALS SHARED ON AS MANY CHANNELS AS POSSIBLE

KEY STAKEHOLDERS

- WATER CUSTOMERS
- STEERING COMMITTEE
- REGULATORS
- LEGISLATORS
- PRIVATE WELL USERS
- LOCAL ELECTED & APPOINTED OFFICIALS
- AGRICULTURAL WATER USERS
- RECREATIONAL USERS
- REAL ESTATE DEVELOPMENT
- LOCAL PRESS/SOCIAL MEDIA

FULL STAKEHOLDER CHART HERE:

HTTPS://WWW.DROPBOX.COM/SCL/FI/CGGIUNL9BISU2TZ7M

JA3M/COMMSTABLE_SHAREABLE.XLSX?

RLKEY=ZINZA3ROD2NXCMMJQMP2TQVRK&DL=0

WATER CUSTOMERS

THE GENERAL PUBLIC - ACTIVITIES TO SUPPORT ATTENDANCE AT WORKSHOPS AND TO DRIVE UP KNOWLEDGE OF THE REGIONAL WATER PLAN

ACTIVITY	LOCATION	SCHEDULE	SUPPORT
Flyers/Postcards	-Vicente's Supermarket (Brockton) -Roche Bros (Easton) -Market Basket (Plymouth, other locations in area) -Libraries of each OCPC community (email flyer or drop off) -MBTA stations (Brockton, Campello, Montello, Bridgewater) -Trader Joe's (Hanover) -Emilson YMCA -Old Colony YMCA branches	Flyers: ~Two weeks prior to workshops Postcard: ASAP through life of the project	OCPC staff to drop postcards and flyers with support from RVA; RVA to supplement drops by emailing libraries, etc. asking them to print and post
Community Meetings	-Out to See (Dubxury) -Cape Verdean Association (Brockton) -Easton Lions Fishing Derby -Multiculturalism Celebration (E. Bridgewater) -Plymouth Waterfront Festival (Chamber event) -Pembroke Arts Festival (Pembroke) -Hanover Day (Hanover)	-Out to See: 5/4/24 -Cape Verdean Assoc: 3rd Sunday of Month -Easton Lions: 5/11/24 -Multiculturalism Celebration: 6/9/24 -Plymouth Waterfront Festival: 8/24/24 -Pembroke Arts Festival: 8/10/24 -Hanover Day: 6/21/24	OCPC to staff with support from RVA
Tabling	-Avon Civic Assoc. Moses Curtis Gazebo Concerts -Duxbury/Plymouth/Brockton Little League -Brockton Farmers Market -Kingston Farmers Market -Pembroke Farmers Market	-Markets: Ongoing (others begin early June) -Concerts: Summer -Little League: Ongoing	OCPC to provide staff with support from RVA
E-Mail/Phone Outreach	-Civic/Green Organizations and Economic Development Organizations (see database)	~Two weeks prior to public meetings	RVA to draft emails and conduct phone outreach
Roundtables	-Environmental Justice Organizations -Senior Organizations	-July, outreach prior	RVA to reach out to potential participants; CDM and OCPC to support materials development and participate in roundtables
Website	N/A	~Three weeks prior to public meetings	~RVA to draft copy, OCPC to upload
General Advertising/Engagement	-Editorial campaign -Cable access -Radio/Podcast (WATD)	-Throughout the project	-RVA to work with OCPC/CDM on editorial strategy/outreach/placement; RVA to liaise with outlets; RVA to work with CDM/OCPC on cable access participation; RVA/CDM/OCPC coordination on possible radio and/or podcast appearance.

STEERING COMMITTEE

ACTIVITY	LOCATION	SCHEDULE	SUPPORT
Steering Committee Meetings	OCPC HQ/Zoom	Monthly	CDM Smith and OCPC to coordinate
Stakeholder Interviews	Virtual	To begin ASAP and last through July 2024	RVA to conduct interviews; one CDM staff to attend; OCPC may attend
Open House/Public Meetings	TBD	June, November, January	RVA and OCPC to coordinate on inviting members

REGULATORS

ACTIVITY	LOCATION	SCHEDULE	SUPPORT
Steering Committee Meetings	OCPC HQ/Zoom	Monthly	CDM Smith and OCPC to coordinate
Stakeholder Interviews	Virtual	To begin ASAP and last through May 2024	RVA to conduct interviews; one CDM staff to attend; OCPC may attend
Open House/Public Meetings	TBD	June, November, January	RVA and OCPC to coordinate on inviting regulators.

LEGISLATORS

ACTIVITY	LOCATION	SCHEDULE	SUPPORT
Steering Committee Meetings	OCPC HQ/Zoom	Monthly	CDM Smith and OCPC coordinate invitation to Sen. Brady & his staff.
Legislative Briefing	TBD	September	CDM Smith & OCPC to coordinate. OCPC may invite Select Board Members
Open House/Public Meetings	TBD	June, November, January	RVA and OCPC to coordinate on inviting legislators & staff.

PRIVATE WELL USERS

ACTIVITY	LOCATION	SCHEDULE	SUPPORT
Steering Committee Meetings	OCPC HQ/Zoom	Monthly	CDM Smith and OCPC coordinate invitation to relevant representatives.
Roundtable	Virtual	June	RVA to host roundtable with materials developed in coordination with CDM/OCPC. CDM/OCPC to attend.
Open House/Public Meetings	TBD	June, November, January	RVA to coordinate on inviting interested parties, including those that participate in roundtable and additional groups/individuals learned through that process.

LOCAL ELECTED & APPOINTED OFFICIALS

ACTIVITY	LOCATION	SCHEDULE	SUPPORT
Stakeholder Interviews	Virtual	To begin ASAP and continue through May 2024	RVA to conduct interviews; OCPC/CDM Smith may be consulted on specific needs.
Legislative Briefing	Virtual	September	CDM/OCPC to coordinate. OCPC may invite Select Board members.
Open House/Public Meetings	TBD	June, November, January	RVA to coordinate on inviting interested parties, including those that participate in legislative briefing and additional groups/individuals learned through that process.

AGRICULTURAL WATER USERS

ACTIVITY	LOCATION	SCHEDULE	SUPPORT
Steering Committee Meeting	OCPC HQ/Zoom	Monthly options	CDM/OCPC to coordinate on potentially inviting a relevant representative to serve as a guest speaker at a Steering Committee meeting/workshop
Interviews	Virtual/TBD	May-July	CDM to coordinate.
Public Meetings	TBD	June, September	RVA to coordinate on inviting interested parties, including those that participate in roundtable and additional groups/individuals learned through that process.

RECREATIONAL WATER USERS

ACTIVITY	LOCATION	SCHEDULE	SUPPORT
Final Report	N/A	Late 2024	CDM to acknowledge the importance of recreational water activities for the region as part of final reporting.
Open House/Public Meetings	TBD	June, November, January	RVA to coordinate on inviting interested parties, including groups concerned specifically with recreation, including: -Duxbury Beach Reservation -Wild Turkey Paddlers -Recreation officials from OCPC cities/towns -Hanson Rod & Gun Club -Chiltonville Fly Fishing Club Outreach will be conducted directly by sending meeting information via e-mail and/or telephone.
Roundtable	-Environmental/Senior Organizations	July	RVA to host roundtable with materials developed in coordination with CDM/OCPC. CDM/OCPC to attend.

REAL ESTATE DEVELOPMENT

ACTIVITY	LOCATION	SCHEDULE	SUPPORT
Steering Committee Meeting	OCPC HQ/Zoom	Monthly options	CDM/OCPC to coordinate on potentially inviting a relevant representative to serve as a guest speaker at a Steering Committee meeting/workshop
Final Report	N/A	Late 2024	CDM to acknowledge the importance of economic development activities for the region as part of final reporting.
Roundtable	TBD	July	RVA to host roundtable with materials developed in coordination with CDM/OCPC. CDM/OCPC to attend.
Open House/Public Meetings	TBD	June, November, January	RVA to coordinate on inviting interested parties, including groups concerned specifically with real estate development, including: -New England Development -Megryco Outreach will be conducted directly by sending meeting information via e-mail and/or telephone.

LOCAL PRESS & SOCIAL MEDIA

ACTIVITY	LOCATION	SCHEDULE	SUPPORT
Social Media	Virtual	~Two weeks prior to events	RVA to draft social media copy ahead of public facing events, OCPC to publish on official channels.
Steering Committee Meetings	OCPC HQ/Zoom	Monthly	As deemed appropriate by CDM/OCPC to do so, RVA to coordinate inviting local press to Steering Committee meetings.
Campaigning	-Editorial campaign -Cable access -Radio/Podcast (WATD)	Throughout the project	-RVA to work with OCPC/CDM on editorial strategy/outreach/placement; RVA to liaise with outlets; RVA to work with CDM/OCPC on cable access participation; RVA/CDM/OCPC coordination on possible radio and/or podcast appearance.
Open House/Public Meetings	TBD	June, November, January	RVA to coordinate on inviting local press and publicizing meetings through local outlets via press releases and direct outreach to local reporters at outlets like: -The Enterprise -The Brazilian Times -Old Colony Memorial -Plymouth Independent -Duxbury Clipper -Local Patches -Facebook groups (Hanson, MA Connect; South Shore Massachusetts Events; All Things Plymouth; All Things Plymouth County; Pembroke Connect) -Local cable access TV RVA to draft press releases, CDM/OCPC to review

COMMUNICATIONS **TOOLS**

PROJECT WEBPAGE

WORK WITH OCPC AND CDM SMITH TO:

- DEVELOP CONTENT FOR A WEBPAGE ON THE OCPC WEBSITE THAT WILL EXPLAIN THE PROJECT GOALS AND ADVISE THE PUBLIC OF PROJECT EVENTS AND STATUS. RVA WILL SEND ANY DRAFTED MATERIALS TO CDM SMITH FOR INITIAL APPROVAL AND CDM WILL THEN SEND TO OCPC
- CREATE EDUCATIONAL MATERIALS FOR THE PUBLIC TO BE HOUSED ON THE PROJECT WEBPAGE.
- MIRROR ANY PUBLIC MEETING NOTICES SENT VIA PROJECT ADVISORIES.
- ENSURE MATERIALS POSTED ARE ACCESSIBLE.

OUTREACH & COMMENTS LOG

AS THE PROJECT UNFOLDS, THE PROJECT TEAM WILL KEEP A LOG FOR BOTH ALL OUTREACH ACTIVITIES PERFORMED AND WHEN, AS WELL AS A LOG FOR ALL COMMENTS AND INQUIRIES THE TEAM RECEIVES, AS WELL AS HOW THE TEAM REPLIED. TRACKING IS A KEY PART OF ANY ENGAGEMENT PROCESS AND OUR TEAM WILL BE ROBUST IN ITS APPROACH.

E-MAIL ADVISORIES & CONTACT DATABASE

WORK WITH OCPC TO:

- PROVIDE CONTENT AS NEEDED FOR BIWEEKLY OCPC NEWSLETTER - CDM SMITH
- PROVIDE INFORMATION ON PUBLIC MEETINGS AND OPPORTUNITIES TO COMMENT - RVA
    - ON PUBLIC FACING MATERIALS, SUCH AS POSTCARDS AND FLYERS, THE WEBSITE WILL BE MENTIONED AS BEST TO COMPEL THE PUBLIC TO VISIT AND SIGN-UP FOR E-MAIL UPDATES. THIS WILL IDEALLY YIELD GREATER PARTICIPATION IN THE PROCESS AND IN THE SURVEY.
    - PUBLIC FACING AND GOVERNMENT E-MAIL ADDRESSES WILL BE ADDED TO A DATABASE THAT WILL BE UTILIZED TO PUBLICIZE PUBLIC MEETINGS AND OPPORTUNITIES TO PARTICIPATE IN INTERVIEWS AND/OR ROUNDTABLES IF APPROPRIATE.
- THE DATABASE WILL BE CONSISTENTLY UPDATED THROUGHOUT THE COURSE OF THE PROJECT. KEY MILESTONES, INCLUDING STEERING COMMITTEE MEETINGS, INTERVIEWS, ROUNDTABLES, AND PUBLIC MEETINGS SHOULD SERVE TO EXPAND THE DATABASE WHILE THE DATABASE SHOULD INCREASE PARTICIPATION IN THOSE MILESTONES - RVA

ONLINE
FEEDBACK

TO GIVE MEMBERS OF THE PUBLIC ANOTHER AVENUE IN WHICH TO ENGAGE WITH THE REGIONAL WATER PLAN DEVELOPMENT PROCESS, AN ONLINE SURVEY WILL BE DEVELOPED BY RVA TO CAPTURE CURRENT IMPRESSIONS, EXPECTATIONS, AND ASPIRATIONS AS THE REGIONAL WATER PLAN TAKES SHAPE.

AS PART OF THIS PROCESS, THE PROJECT TEAM WILL WORK TOGETHER TO DETERMINE WHICH PIECES OF DATA WILL BEST INFORM THE NEEDS OF THE PROJECT AND WHICH SURVEY PLATFORM, SUCH AS GOOGLE FORMS, QUALTRICS, OR SURVEY MONKEY, WILL BEST SERVE THIS PURPOSE. ADDITIONALLY, RVA WILL CONSULT WITH CDM SMITH AND OCPC ON THE TIMING OF THE SURVEY AS BEST TO YIELD AS MUCH DATA AS POSSIBLE. FOR EXAMPLE, THE SURVEY SHOULD NOT RUN IN THE SUMMER, WHEN MANY ARE ON VACATION.

THE SURVEY WILL BE HOSTED ON THE PROJECT WEBSITE AND WILL BE LINKED IN E-MAILS TO RELEVANT STAKEHOLDERS, INCLUDING TOWN OFFICIALS, GREEN ORGS, AND ECONOMIC DEVELOPMENT ORGANIZATIONS.

KEY
ENGAGEMENT ACTIVITIES

PUBLIC MEETINGS

JUNE; NOVEMBER; JANUARY 2025

ROUNDTABLES

2 IN JUNE; 2 IN JULY

INTERVIEWS

THROUGH JULY

SMALL GROUP
ROUNDTABLES

- ROUNDTABLE DISCUSSIONS FOR KEY STAKEHOLDER GROUPS, INCLUDING PRIVATE WELL USERS, ENVIRONMENTAL PROFESSIONALS AND ADVOCATES, AND ENVIRONMENTAL JUSTICE & SENIOR ORGANIZATIONS.
- WE EXPECT TO HOLD FOUR (4) CONSULTATIONS SPREAD OUT DURING THE MONTHS OF **JUNE AND JULY.**
- THE PROJECT TEAM WILL CRAFT EACH ROUNDTABLE AROUND THE BACKGROUNDS OF THOSE INVITED TO ATTEND. RVA WOULD WORK WITH ITS PARTNERS TO INVITE AN APPROPRIATE NUMBER OF RELEVANT STAKEHOLDERS TO PARTICIPATE IN THE CONSULTATION PROCESS.
- RVA TO TAKE DETAILED NOTES AND CDM SMITH TO INCORPORATE INTO THE FINAL REPORT AS APPROPRIATE.
- RVA WILL SCHEDULE EACH ROUNDTABLE AND WILL CONDUCT DIRECT OUTREACH TO REQUESTED INVITEES. OCPC AND CDM SMITH WILL ATTEND EACH EVENT.
- RVA WILL COORDINATE WITH AGENCIES LIKE MEPA TO OBTAIN LISTS OF RELEVANT ORGANIZATIONS IN THE ENVIRONMENTAL JUSTICE SPACE, FOR EXAMPLE, FOR INCLUSION IN A ROUNDTABLE EVENT.
- LANGUAGE INTERPRETATION SERVICES WILL BE AVAILABLE UPON REQUEST FOR ROUNDTABLE PARTICIPANTS.
- A $10 GIFT CARD WILL BE PROVIDED TO CERTAIN ATTENDEES OF ROUNDTABLE EVENTS TO COMPENSATE THEIR TIME.

STAKEHOLDER INTERVIEWS

AD-HOC STYLE INTERVIEWS WITH ENTITIES AND INDIVIDUALS, INCLUDING CDM SMITH, MEMBERS OF THE STEERING COMMITTEE AND CITY/TOWN OFFICIALS. THESE INTERVIEWS WOULD BE CONDUCTED WITH THOSE THAT COULD NOT OR WERE NOT INVITED TO ATTEND ROUNDTABLES BUT MAY OTHERWISE PROVIDE VALUABLE FEEDBACK TO THE PROCESS. RVA WILL TAKE DETAILED NOTES THAT CDM SMITH WILL INCLUDE IN THE FINAL REPORT AS APPROPRIATE.

FORMAT

ONE INTERVIEW WILL BE SCHEDULED WITH EACH COMMUNITY AND/OR ASSOCIATION, TO LAST NO MORE THAN 60 MINUTES. THE FORMAT OF STAKEHOLDER INTERVIEWS WILL BE SEMI-STRUCTURED, WITH EACH PARTICIPANT BEING ASKED THE SAME QUESTIONS WITH THE EXPECTATION THAT NO TWO CONVERSATIONS WILL BE THE SAME. PARTICIPANTS, THROUGH THEIR RESPONSES, WILL BE ALLOWED TO DETERMINE THE TRAJECTORY OF EACH INTERVIEW AND CONVENERS WILL BE PREPARED TO ASK RELEVANT FOLLOW-UP QUESTIONS THAT MAY BE UNIQUE TO EACH INTERVIEWEE.

QUESTIONS WILL INCLUDE:

-ARE THE VULNERABILITIES IN YOUR WATER SYSTEM GREAT ENOUGH THAT YOU ABSOLUTELY NEED A BETTER WAY IN ORDER TO COMPLY WITH REGULATIONS AND TO PROVIDE WATER SECURITY IN YOUR COMMUNITY?

-WHAT WATER PROJECTS HAVE YOU EXPLORED EITHER AS STAND-ALONE PROJECTS OR IN TANDEM WITH OTHER COMMUNITIES?

-ARE THERE CERTAIN WATER PROJECTS THAT YOU HAVE ALREADY DETERMINED THAT YOU WILL NOT SUPPORT IN YOUR COMMUNITY?

-DO YOU SEE YOUR SYSTEM AS HAVING ENOUGH RESOURCE AND OPERATIONAL FLEXIBILITY TO BENEFIT COMMUNITIES OTHER THAN YOUR OWN, AND IS THIS SOMETHING YOU WISH TO PURSUE?

-DO YOU HAVE CONCERNS ABOUT A REGIONAL PLANNING PROCESS SUCH AS THIS? DO YOU HAVE CONCERNS SPECIFIC TO ANY OTHER ENTITIES PARTICIPATING IN THE PROCESS?

-WHERE IS WATER SECURITY IN YOUR LIST OF PRIORITIES AMONG THE ISSUES YOU FACE AS A COMMUNITY?

-WHAT TYPE OF FINANCIAL CONSTRAINTS COULD AFFECT YOUR DECISION TO SUPPORT CERTAIN PROJECTS?

-WHAT TYPE OF POLITICAL CONSTRAINTS COULD AFFECT YOUR DECISIONS?

-WHAT OPERATIONAL OR STAFFING LIMITATIONS MAY AFFECT YOUR DECISION TO SUPPORT CERTAIN PROJECTS?

-ADDITIONAL QUESTIONS MAY BE ADDED FROM A COMMUNITY'S ANNOTATED BIBLIOGRAPHY REPORT SECTION

PRESS/ADVERTISING

RATHER THAN PUBLISH PAID LEGAL ADVERTISING AHEAD OF PUBLIC MEETINGS AND OTHER RELEVANT EVENTS, RVA WILL INSTEAD ENGAGE IN DIRECT OUTREACH TO LOCAL JOURNALISTS, NEWSPAPERS, AND (IF APPROPRIATE) SOCIAL MEDIA GROUPS TO ADVERTISE THE PROJECT. THE GOAL WOULD BE TO GENERATE STORIES ABOUT THE PROJECT AND GRASSROOTS INTEREST IN THE WORK WHILE EDUCATING THE PUBLIC ABOUT WATER ISSUES IN THE REGION. IDEALLY, JOURNALISTS MAY SEEK COMMENT/INTERVIEWS FROM THE TEAM.

POTENTIAL OUTLETS

THE ENTERPRISE
THE BRAZILIAN TIMES
THE DUXBURY CLIPPER
OLD COLONY MEMORIAL
PLYMOUTH INDEPENDENT
PATCH NETWORK
VETTED SOCIAL MEDIA GROUPS

PRINT MATERIALS

TO SUPPORT PUBLIC ACTIVITIES, INCLUDING PUBLIC MEETINGS AND SURVEY OPPORTUNITIES, RVA WILL DEVELOP PRINT MATERIALS INCLUDING FLYERS AND AN EVERGREEN POSTCARD AS BEST TO GENERATE INTEREST AND ENGAGEMENT IN THE WATER PLAN DEVELOPMENT PROCESS.

THESE MATERIALS WILL FEATURE MULTIPLE OCPC COLORS DESIGNED TO CAPTURE THE ATTENTION OF PASSERSBY. EACH PIECE WILL FEATURE A QR CODE FOR QUICK ENGAGEMENT OPPORTUNITIES AND EACH PIECE WILL BE TRANSLATED INTO RELEVANT AREA LANGUAGES, INCLUDING PORTUGUESE, SPANISH, HAITIAN CREOLE, AND CAPE VERDEAN CREOLE.

Appendix G
Regional Water Plan Webpage

OLD COLONY PLANNING COUNCIL

Search...

English

Expertise & Services
Get Involved
Resources
Calendar
About

Planning for Resilient Water Supply

Upcoming Meetings and Events

There are no upcoming events.

Staff Contact

Joanne Zygmunt, Senior Planner

jzygmunt@ocpcrpa.org or (774) 539-5059

The Regional Water Survey is NOW LIVE!

OCPC and the Steering Committee are seeking your feedback to guide the region's first plan for resilient water supply! We need your help. Please take just ten minutes to complete this anonymous survey to tell us how what you think about drinking water quality, environmental protection, and affordability/reliability.

Click Here to Take the Survey

The first Regional Water Plan for the Old Colony Region is under development. To stay up-to-date, subscribe to the OCPC Newsletter and review minutes from Steering Committee meetings. All meetings are open to the public.

Our region faces critical water challenges, such as decreasing well depths, rising demand due to development, water quality issues, and ecological damage. OCPC is leading a joint effort to plan for future water supply while tackling immediate vulnerabilities. The aim is to help ensure affordable, safe, abundant, and ecologically sustainable water now and into the future.

Seventeen cities and towns, along with state and federal regulators, elected officials, environmental groups, and businesses, are working together to improve water management and infrastructure. This collaborative approach is essential because local water management alone is no longer adequate.

Steering English

Membership

Terms of Reference

January 29, 2024: Agenda | Minutes | Slides | Materials

February 28, 2024: Agenda | Minutes | Slides | Materials

March 18, 2024: Agenda | Minutes | Slides | Materials

April 23, 2024: Agenda | Minutes | Slides

May 20, 2024: Agenda | Minutes | Slides

June 25, 2024: Agenda | Minutes | Slides

Learn more about the project's launch by reading the Press Release or watching the Press Conference.

+ Why do we need a Regional Water Plan?

+ What will the plan accomplish?

+ What will the plan look like? What will be included?

+ Is there a Steering Committee? Who is on it?

+ How is this project funded?

+ Who is doing the work? How were the consultants selected?

July 31, English es | Slides | Materials

August 27, 2024: Agenda | Minutes | Slides | Materials

September 24, 2024: Agenda | Minutes | Slides | Materials

October 29, 2024: Agenda | Minutes | Slides | Materials

November 18, 2024: Minutes| Slides|Materials

Thank You to Our Funding Partners

NARRAGANSETT BAY ESTUARY PROGRAM

EDA U.S. ECONOMIC DEVELOPMENT ADMINISTRATION

Central Plymouth County Water District Commission

English

Sign up to receive updates & resources

Your email address

Sign up

English

OLD COLONY
PLANNING COUNCIL

70 School Street,
Brockton, MA 02301

508-583-1833

508-559-8768

Contact OCPC
Staff Directory

Office Hours
Mon. - Fri. 8:30AM – 4:00PM

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Appendix G
Regional Water Plan Public Survey
Promotional Materials

Participate today!

REGIONAL WATER SURVEY

What do you think about?

- ✓ Drinking water quality
- ✓ Environmental protection
- ✓ Affordability and reliability

www.surveymonkey.com/r/waterplan

Your input will help guide the development of the region's first plan for resilient water supply

OLD COLONY
PLANNING COUNCIL

Supporting the communities of
Abington, Avon, Bridgewater, Brockton, Duxbury, East Bridgewater, Easton, Halifax, Hanover, Hanson, Kingston, Pembroke, Plymouth, Plympton, Stoughton, West Bridgewater, and Whitman

Learn more about this project at
www.oldcolonyplanning.org/waterplan

Participate today!

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Learn more about this project at
www.oldcolonyplanning.org/waterplan

Appendix G
Regional Water Plan Public Survey

OLD COLONY
PLANNING COUNCIL

2024 Regional Water Survey of Households

Old Colony Planning Council, the regional planning agency for the greater Brockton and Plymouth areas, has partnered with consulting firm CDM Smith, the 17 municipalities in our region, and other stakeholders to develop a Regional Water Plan. This collaborative plan will help ensure safe, sustainable water now and into the future.

We need your help. Your views are important to us. **Please take just ten minutes to complete this anonymous survey.** It will close soon. We'll use what we learn from you to inform development of the plan.

Only with your help can we develop a plan best suited for communities in our region. Thank you for your input!

You can learn more about this project at https://oldcolonyplanning.org/waterplan/. If you have any questions, please contact Joanne Zygmunt at jzygmunt@ocpcrpa.org or (774) 539-5059.

1. Where do you live? *Please choose one answer from the dropdown.*

2. Which of the following sources of water do you use inside your home? *Please choose one answer.*

- ○ Water supplied by the town/city
- ○ Private well water

OLD COLONY PLANNING COUNCIL

2024 Regional Water Survey of Households

3. Which of the following sources of water do you use for the following? *Please tick one or more boxes per row.*

	Public water supply from my town/city	Private well water	Collected rainwater	Purchased bottled water	I don't use water for this purpose
Drinking	☐	☐	☐	☐	☐
Cooking	☐	☐	☐	☐	☐
Other indoor uses	☐	☐	☐	☐	☐
Outdoor watering/irrigation	☐	☐	☐	☐	☐
Other outdoor uses	☐	☐	☐	☐	☐

4. Which, if any, of the following water filtration/treatment options do you use? *Tick one or more boxes.*

- ☐ We don't filter/treat our water
- ☐ Water filtering pitcher
- ☐ Fridge with filtered water dispenser
- ☐ Kitchen sink filtration system
- ☐ Filtering showerhead
- ☐ Whole home filtration system
- ☐ Whole home water softener
- ☐ Other (please specify): ____________________
- ☐ I don't know

OLD COLONY
PLANNING COUNCIL

2024 Regional Water Survey of Households

5. Why did you decide to filter/treat your water? *Tick one or more boxes.*

- ☐ To improve taste
- ☐ To improve color or clarity
- ☐ To improve smell
- ☐ To improve safety or health
- ☐ To reduce hardness
- ☐ I didn't decide - filtration/treatment was already installed
- ☐ I didn't decide - someone else in my household wanted to
- ☐ Other (please specify):

6. To what extent are you aware of your town/city's annual Water Quality Report for public water supply? *Choose one answer.*

- ◯ I received, read, and understood it
- ◯ I received and read it, but didn't understand it
- ◯ I received it, but didn't read it
- ◯ I didn't receive it / Not sure I saw it

7. To what extent do you agree or disagree with the following? *Choose one answer for each row. If you don't read your bill or don't receive a bill at all, select* "*Not applicable.*"

	Strongly disagree	Tend to disagree	Neither disagree nor agree	Tend to agree	Strongly agree	Not applicable
My water bill provides enough information so that I understand how much water my household uses	◯	◯	◯	◯	◯	◯
Water bills should compare my household's water use to other similar households, like on my electricity bill	◯	◯	◯	◯	◯	◯
I understand how my water bill is calculated	◯	◯	◯	◯	◯	◯
The cost of my water service is reasonable	◯	◯	◯	◯	◯	◯
I would pay more to protect and improve the environmental health of our water supplies	◯	◯	◯	◯	◯	◯

OLD COLONY PLANNING COUNCIL

2024 Regional Water Survey of Households

8. Which of the following sources of water do you use for the following? *Please tick one or more boxes per row.*

	Private well water	Collected rainwater	Purchased bottled water	I don't use water for this purpose
Drinking	☐	☐	☐	☐
Cooking	☐	☐	☐	☐
Other indoor uses	☐	☐	☐	☐
Outdoor watering/irrigation	☐	☐	☐	☐
Other outdoor uses	☐	☐	☐	☐

9. When was the last time your well water was tested for quality? *Choose one answer.*

- ◯ Within the last year
- ◯ 1 to 3 years ago
- ◯ More than 3 years ago
- ◯ It's never been tested as far as I know
- ◯ Don’t know

OLD COLONY
PLANNING COUNCIL

2024 Regional Water Survey of Households

10. What is the main reason why you haven't tested your well water? *Choose one answer.*

- ◯ Not concerned about quality or safety
- ◯ Didn't know about testing
- ◯ Not sure what to do or who to contact
- ◯ Testing and/or treatment is too expensive
- ◯ Treatment systems are too difficult to use/maintain
- ◯ Planning to, but haven’t gotten around to it yet
- ◯ Other (please specify):

OLD COLONY
PLANNING COUNCIL

2024 Regional Water Survey of Households

11. Did you test for PFAS (sometimes called PFOA, PFOS, or "forever chemicals")? *Please choose one answer.*

- ◯ Yes
- ◯ Planning to
- ◯ No
- ◯ I don't know

OLD COLONY
PLANNING COUNCIL

2024 Regional Water Survey of Households

12. If you have ever noticed any changes in the volume of water available in your well, please explain what you observed and when:

13. If you had the option to connect to public water supply at a reasonable cost, would you?

- ◯ Yes
- ◯ Maybe
- ◯ No
- ◯ Don't know

Please explain you answer here:

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14. How would you rate the tap water in your home for the following? *Choose one answer per row.*

	Poor	Fair	Good	Very good	Excellent
Quality	○	○	○	○	○
Reliability	○	○	○	○	○
Affordability	○	○	○	○	○

15. Over the past three years, do you think the safety of your tap water has improved, worsened, or stayed about the same? *Choose one answer.*

- ○ Worsened
- ○ Stayed about the same
- ○ Improved
- ○ I don't know

16. Over the past one year, have you contacted your town/city about any water-related issue? *Please choose one answer.*

- ○ Yes
- ○ No
- ○ I don't know

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17. What did you contact them about? *Please tick one or more boxes.*

- ☐ Issue with water quality (color, appearance, smell, or taste)
- ☐ Bill or water rate question
- ☐ Flooding or stormwater concern
- ☐ Drought concern
- ☐ Low well level
- ☐ Water leak
- ☐ Concern about water safety
- ☐ Issue with water pressure
- ☐ Reported someone breaking water ban/restrictions
- ☐ Needed help paying for water
- ☐ Moved house
- ☐ Something else (please specify):

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18. How concerned are you, if at all, about the following? *Choose one answer per row.*

	Not at all concerned	Slightly concerned	Somewhat concerned	Moderately concerned	Very concerned
Aging water infrastructure	○	○	○	○	○
Human water use negatively impacting the natural environment	○	○	○	○	○
Health of local fisheries	○	○	○	○	○
Sufficient availability of water for ecosystems, including wildlife	○	○	○	○	○
Climate change impacts to water quality and quantity	○	○	○	○	○
Contamination of water sources, including lakes and groundwater	○	○	○	○	○

19. Do you think your town/city is doing enough to... *Please choose one answer per row.*

	Yes	No	Not sure
protect the natural source of your water (usually a lake and/or groundwater)?	○	○	○
help households conserve water?	○	○	○
repair and upgrade aging water infrastructure?	○	○	○

20. Do you think **the state** is doing enough to... *Please choose one answer per row.*

	Yes	No	Not sure
protect the natural source of your water (usually a lake and/or groundwater)?	○	○	○
help households conserve water?	○	○	○
repair and upgrade aging water infrastructure?	○	○	○

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It's important for us to hear from a variety of people. That's why we ask the following demographic questions. Your answers will help us understand who is participating in this survey and who we need to reach out to more. This remains an anonymous survey.

21. How old are you? *Please choose one answer.*

- ○ Under 18
- ○ 18-24
- ○ 25-34
- ○ 35-44
- ○ 45-54
- ○ 55-64
- ○ 65+
- ○ Prefer not to say

22. What is your living situation? *Choose one answer.*

- ○ Rent
- ○ Own
- ○ Temporary/unhoused
- ○ Other (please specify):
- ○ Prefer not to say

23. Do any children under the age of 18 live with you? *Choose one answer.*

- ○ Yes
- ○ No
- ○ Prefer not to say

24. Which of the following best describes you? *Please choose one answer.*

- ◯ Asian or Pacific Islander
- ◯ Black of African American
- ◯ Hispanic or Latino
- ◯ Native American or Alaskan Native
- ◯ White or Caucasian
- ◯ Multiracial or Biracial
- ◯ A race/ethnicity not listed here
- ◯ Prefer not to say

25. Which of the following best describes your gender? *Please choose one answer.*

- ◯ Woman
- ◯ Man
- ◯ Non-binary
- ◯ Prefer to self-identify: __________
- ◯ Prefer not to say

26. What is your annual household income before taxes? *Please choose one answer.*

- ◯ Less than $25,000
- ◯ $25,000 to $49,999
- ◯ $50,000 to $99,999
- ◯ $100,000 to $149,999
- ◯ $150,000 to $200,000
- ◯ More than $200,000
- ◯ Prefer not to say

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Thank you!

27. Your time and input is valuable to us. If there's anything more you'd like to share about water-related issues or have suggestions for what to include in the Regional Water Plan, please tell us here:

28. A draft Regional Water Plan will be available for public comment in early 2025. If you would like to be notified of it as well as related public meetings, please provide your email address below. Your email will not shared with any third parties.

Email address

We very much appreciate you taking this time to share your thoughts and opinions with us. It's only with your help that we can develop a plan best-suited for our region. Thank you for your input!

If you have any questions about this project, please contact Joanne Zygmunt at jzygmunt@ocpcrpa.org or (774) 539-5059.

More information about the project is available at https://oldcolonyplanning.org/waterplan/.

Please click "Done" below to finish this survey.

Appendix H Potential Grant and Funding Opportunities

Appendix H – Potential Grant and Funding Opportunities

1. MWRA Local Water System Assistance Program (LWSAP)
    - OCPC Eligible Entities: Stoughton only
    - Eligible Projects: to perform water system improvement projects
    - Funding: 0% interest loan
    - Link: https://www.mwra.com/projects-programs/major-programs/local-water-system-assistance
2. MWRA Lead Service Line Replacement Loan Program
    - OCPC Eligible Entities: Stoughton only
    - Eligible Projects: for efforts to fully replace lead service lines
    - Funding: 0% interest loan and a 25% grant component
    - Link: https://www.mwra.com/projects-programs/major-programs/lead-service-line-replacement-program
3. MWRA Water Conservation
    - OCPC Eligible Entities: Stoughton only
    - Eligible Projects: Water Conservation Brochures, Low-Flow Water Fixtures, Leak Detection Survey
    - Funding: Materials provided free of charge; Leak Detection Survey billed to community the following year
    - Link: https://www.mwra.com/your-water-system/water-conservation
4. MassDEP Drinking Water State Revolving Fund (SRF) Programs
    - OCPC Eligible entities: All public water suppliers
    - Eligible Projects: planning, engineering, and construction of drinking water infrastructure projects, such as construction of new water treatment facilities, that protect public health and improve compliance with federal and state regulations, expansion, upgrades, rehab of existing facilities, etc.
    - Funding: 2% interest loan
    - Additional subsidy available for Housing Choice Communities up to 0.5% interest rate reduction: Bridgewater, Brockton, Easton, Plymouth, Stoughton
    - Additional Loan Forgiveness for Disadvantaged Communities, ranging from 3.3%-19.8%): Abington, Avon, Bridgewater, Brockton, East Bridgewater, Halifax, Hanson, Kingston, Pembroke, Plymouth, Plympton, Stoughton, West Bridgewater, Whitman
    - Link: https://www.mass.gov/info-details/drinking-water-state-revolving-fund-srf-program
5. MassDEP State Revolving Fund (SRF) PFAS Mitigation Loans
    - OCPC Eligible entities: All public water suppliers
    - Eligible Projects: projects that have the purpose of reducing PFAS in water below the established Maximum Contamination Level (MCL)
    - Funding: 0% interest loan

   - Additional subsidy available for Housing Choice Communities up to 0.5% interest rate reduction: Bridgewater, Brockton, Easton, Plymouth, Stoughton
   - Additional Loan Forgiveness for Disadvantaged Communities, ranging from 3.3%-19.8%): Abington, Avon, Bridgewater, Brockton, East Bridgewater, Halifax, Hanson, Kingston, Pembroke, Plymouth, Plympton, Stoughton, West Bridgewater, Whitman
   - Link: https://www.mass.gov/info-details/pfas-mitigation-loans-0-interest

6. MassDEP State Revolving Fund Lead Service Line Replacement Program
   - OCPC Eligible entities: All public water suppliers
   - Eligible projects: planning and replacement of Lead Service Lines
   - Funding: 0% interest construction loan and Planning Program Grant
   - Link: https://www.mass.gov/info-details/lead-service-line-replacement-program
7. MassDEP State Revolving Fund Emerging Contaminants Small and Disadvantaged Communities Grant
   - OCPC Eligible entities: Public water suppliers serving less than 10,000 population and located in a disadvantaged community (Avon, Halifax, Plympton, Stoughton, West Bridgewater)
   - Eligible projects: research and testing, planning and design to address emerging contaminants, treatment of emerging contaminants, source water activities related to emerging contaminants, storage, water system restructuring, interconnection, consolidation, or creation, providing households access to drinking water services, technical assistance, public communication, engagement, and education, workforce development
   - Funding: Grant. Past grant awards have ranged up to $4 Million
   - Link: https://www.mass.gov/info-details/emerging-contaminants-in-small-or-disadvantaged-communities-grant
8. MassDEP Water Management Act Program Grant
   - OCPC Eligible entities: All public water suppliers
   - Eligible projects: Assists eligible public water suppliers and municipalities that hold Water Management Act permits and registrations by providing funds for planning assistance, demand management, and withdrawal impact mitigation projects in local communities
   - Funding: 10 grants per year. 80% reimbursement and 20% match required. Total grant funding in FY25 was approximately $1 Million.
   - Link: https://www.mass.gov/info-details/water-management-act-grant-programs-for-public-water-suppliers#statewide-water-management-act-grant-
9. Assistance Program for Lead in School Drinking Water
   - OCPC Eligible Entities: public and private schools and childcare facilities
   - Eligible projects: free and easy drinking water lead testing, along with access to results, and solutions for elevated levels of lead, if found.
   - Funding: Free
   - Link: https://www.mass.gov/info-details/water-resources-grants-financial-assistance#assistance-program-for-lead-in-school-drinking-water-

10. School Water Improvement Grants Program:
    - OCPC Eligible Entities: Schools, early education facilities, non-residential childcare facilities
    - Eligible projects: purchase and installation of point-of-use filtered water bottle filling stations that have completed drinking water testing.
    - Funding: $3,000 per filling station
    - https://www.mass.gov/info-details/school-water-improvement-grants-program
11. Drinking Water Supply Protection Grant Program
    - OCPC Eligible Entities: All public water suppliers/municipalities
    - Eligible projects: purchase of land or interests in land for the following purposes: 1) protection of existing DEP-approved public drinking water supplies; 2) protection of planned future public drinking water supplies; or 3) groundwater recharge.
    - Funding: 60% grant, 40% match. Max Award: $350,000.
    - Link: https://www.mass.gov/info-details/drinking-water-supply-protection-grant-program
12. M36 Water Audit Opportunity
    - OCPC Eligible Entities: All public water suppliers
    - Eligible projects: American Water Works Association (AWWA) M36 "Top Down" Audit from a private consulting firm
    - Funding: Free
    - Link: https://www.mass.gov/info-details/water-management-act-grant-programs-for-public-water-suppliers#m36-water-audit-opportunity-
13. American Water Works Association
    - OCPC Eligible Entities: All public water suppliers
    - Eligible Projects: Provides access to rate survey digital platform
    - Funding: One-Year Subscription Cost of $199
    - https://www.awwa.org/data-products/rate-survey/
14. Statewide GIS Mapping Technical Assistance
    - OCPC Eligible Entities: All public water suppliers
    - Eligible projects: identifying resiliency resources, finding opportunities for local and regional partnerships, offering infrastructure mapping and adaptation planning assistance, and coordinating training opportunities
    - Funding: state staff technical assistance
    - Link: https://www.mass.gov/info-details/water-management-act-grant-programs-for-public-water-suppliers#statewide-gis-mapping-technical-assistance-
15. Healthy Lawns, Happy Summer Toolkit
    - OCPC Eligible Entities: All public water suppliers
    - Eligible projects: Ready-to-use public education toolkit customized to household water use with the goal of reducing water use by largest residential users
    - Funding: Free
    - Link: https://www.mass.gov/info-details/water-management-act-grant-programs-for-public-water-suppliers#healthy-lawns,-happy-summer-toolkit-

16. Section 604(b) Water Quality Management Planning Grant Program
    - OCPC Eligible Entities: All public water suppliers/municipalities, regional planning agencies
    - Eligible projects: projects that determine the nature, extent, and causes of water quality issues and to develop plans to restore or protect water quality pursuant to the CWA and Massachusetts Surface Water Quality Standards (i.e., climate resilient designs and implementation plans that address water impairments)
    - Funding: Grant. $900K was available in FY23. Match not required but increases competitiveness.
    - Link: https://www.mass.gov/info-details/grants-financial-assistance-watersheds-water-quality#section-604(b)-water-quality-management-planning-grant-program-
17. Section 319 Nonpoint Source Competitive Grants Program
    - OCPC Eligible Entities: All public water suppliers/municipalities, regional planning agencies
    - Eligible projects: implementation projects that address the prevention, control, and abatement of nonpoint source (NPS) pollution.
    - Funding: Grant. $3.1 Million was available in FY23-24. 40% match was waived by MassDEP for FY23-24.
    - Link: https://www.mass.gov/info-details/grants-financial-assistance-watersheds-water-quality#section-319-nonpoint-source-competitive-grants-program-
18. Water Quality Monitoring Grant Program
    - OCPC Eligible Entities: federally recognized Tribal Nations within MA; and non-profit organizations that may include watershed groups, lake and pond associations, and other non-profit organizations.
    - Eligible projects: projects that support ongoing or new monitoring and data collection efforts to increase the amount of external data MassDEP uses for water quality assessments under the federal Clean Water Act. Such initiatives, include: (1) direct monitoring of rivers, streams, lakes, ponds, and estuaries (surface waters) through field and laboratory work; (2) associated capacity building actions (including, but not limited to training and outreach) that improve the organization's ability to monitor surface waters through field and laboratory work; and (3) developing regional and long-term monitoring programs and networks.
    - Funding: Grant. Up to $200K available for FY25. Grant awards may range from $20K-$75K.
    - Link: https://www.mass.gov/info-details/grants-financial-assistance-watersheds-water-quality#water-quality-monitoring-grant-program-
19. EPA Water Infrastructure Finance and Innovation Act (WIFIA)
    - OCPC Eligible Entities: All public water suppliers/municipalities, partnerships/joint ventures, corporations/trusts
    - Eligible Projects: Projects that are eligible for the Drinking Water SRF, Brackish or seawater desalination, aquifer recharge, alternative water supply, and water recycling projects, drought prevention, reduction, or mitigation projects. Project scope can include planning, preliminary engineering, design, environmental review, revenue forecasting, and other pre-construction activities, construction, reconstruction, rehabilitation, and replacement activities, acquisition of real property or an interest in

real property, environmental mitigation, construction contingencies, and acquisition of equipment
- Funding: long-term, low-cost loans. WIFIA loans can provide up to 49 percent of the financing and the SRF loans could finance some or all of the remaining eligible project costs.
- https://www.epa.gov/wifia/about-wifia

20. USDA Rural Development Water and Waste Disposal Grant
    - OCPC Eligible Entities: Rural areas/towns serving less than 10,000 population (Avon, Halifax, Plympton, Stoughton, West Bridgewater)
    - Eligible Projects: acquisition, construction or improvement of: Drinking water sourcing, treatment, storage and distribution; Sewer collection, transmission, treatment and disposal; Solid waste collection, disposal and closure; Storm water collection, transmission and disposal
    - Funding: Long-term, low-interest loans. If funds are available, a grant may be combined with a loan if necessary to keep user costs reasonable.
    - https://www.rd.usda.gov/programs-services/water-environmental-programs/water-waste-disposal-loan-grant-program
21. Southeast New England Program (SNEP) Watershed Implementation Grants (SWIG)
    - OCPC Eligible Entities: SNEP Communities
    - Eligible Projects: water quality and ecosystem restoration
    - Funding: Varies by grant program
    - https://www.epa.gov/snep/about-southeast-new-england-program
22. Buzzards Bay National Estuary Program
    - OCPC Eligible Entities: Portion of Town of Plymouth in Buzzards Bay Watershed
    - Eligible Projects: planning, design, and construction of stormwater facilities, MS4 compliance, nutrient removal, ecological restoration, land preservation, etc.
    - Funding: Grant. No match required. Max award up to $375,000.
    - https://buzzardsbay.org/our-program/funding/
23. Transformational Habitat Restoration and Coastal Resilience Grants
    - OCPC Eligible Entities: Municipalities, tribal organizations, small businesses, higher education institutes, nonprofits, for profit organizations, and more.
    - Eligible Projects: projects that restore marine, estuarine, coastal, or Great Lakes ecosystems, using approaches that enhance community and ecosystem resilience to climate hazards. Projects that demonstrate significant impacts; rebuild productive and sustainable fisheries; contribute to the recovery and conservation of threatened and endangered species; promote climate-resilient ecosystems, especially in tribal, indigenous, and/or underserved communities; and improve economic vitality, including local employment.
    - Funding: NOAA will accept proposals between $750,000 and $10 Mil for the entire award, with typical funding anticipated to range from $4 Mil to $6 Mil.
    - https://www.fisheries.noaa.gov/grant/transformational-habitat-restoration-and-coastal-resilience-grants
24. MVP Funding (MVP 2.0 and MVP Action Grant)
    - OCPC Eligible Entities: All municipalities
    - Eligible Projects: Increasing resilience to climate change by building off of and filling gaps from the original MVP Planning Grant (1.0). Projects that build climate resilience (i.e., vulnerability assessment of a specific sector to an outreach, engagement campaign,

  constructing green infrastructure). Projects that utilize best available climate change data and projections, that are rooted in natural systems as much as possible, and that center environmental justice and equity.
  - Funding: MVP 2.0: $50,000 (no match required), MVP Action Grant: $37 Million total available in FY25. Max $3M per project or $5M for regional project (10% match required)
  - https://resilient.mass.gov/mvp/
25. Massachusetts Community Health and Healthy Aging Funds (the Funds)
  - OCPC Eligible Entities: Community-based nonprofit organizations, municipalities, quasi-governmental organizations, and community groups or coalitions with a 501c3 fiscal sponsor.
  - Eligible Projects: Projects that assist organizations and communities in addressing the root causes of health inequities. The Funds focus on addressing health and racial inequities through community-centered policy, systems, and environmental change approaches.
  - Funding: $50,000-$375,000 Grant. No match required.
  - https://mahealthfunds.org/
26. EPA Brownfield Program
  - OCPC Eligible Entities: All municipalities
  - Eligible Projects: Community-wide Assessment Grants, Assessment Coalition Grants, Cleanup Grants, Revolving Loan Fund, Job Training Grants, Technical Assistance, State and tribal response program funding
  - Funding: Varies by program
  - https://www.epa.gov/brownfields/grants-and-funding
27. EPA Technical Assistance Grant (TAG)
  - OCPC Eligible Entities: All municipalities with superfund sites (Bridgewater, Holbrook, and Plymouth)
  - Eligible Projects: Helps communities participate in Superfund cleanup decision-making
  - Funding: $50K initial grant.
  - https://www.epa.gov/superfund/technical-assistance-grant-tag-program
28. FEMA Grants
  - OCPC Eligible Entities: All municipalities
  - Eligible Projects: Varies by program (Preparedness, Hazard Mitigation, National Dam Safety Program, and more)
  - Funding: Grants vary by program
  - https://www.fema.gov/grants
29. Bipartisan Infrastructure Law
  - OCPC Eligible Entities: All municipalities
  - Eligible Projects: Various water and environmental projects
  - Funding: varies by program
  - https://www.fhwa.dot.gov/bipartisan-infrastructure-law/grant_programs.cfm

30. EPA Green Infrastructure Funding and Technical Assistance
    - OCPC Eligible entities: All municipalities
    - Eligible Projects: stormwater and green infrastructure
    - Funding: Grants vary by program
    - https://www.epa.gov/green-infrastructure/green-infrastructure-funding-and-technical-assistance-opportunities
31. Stormwater MS4 Municipal Assistance Grant Program
    - OCPC Eligible Entities: All municipalities
    - Eligible projects: Projects that result in tools or strategies that will help multiple municipalities meet one or more requirement(s) of the 2016 Small MS4 General Permit.
    - Funding: Grant. $250,000 available in FY25. Awards range from $50K-$250K.
    - https://www.mass.gov/info-details/grants-financial-assistance-watersheds-water-quality#stormwater-ms4-municipal-assistance-grant-program-
32. Good Agricultural Practices (GAP)/Good Handling Practices (GHP) Audit Reimbursement
    - OCPC Eligible Entities: All agricultural growers/operators
    - Eligible projects: research projects that address challenges and opportunities in marketing, transportation, and distribution of agricultural products.
    - Funding: Reimbursement to cover the cost of the audit.
    - https://www.mass.gov/guides/agricultural-grants-and-financial-assistance-programs#:~:text=GAP%2FGHP%20Reimbursement,GAP%2FGHP%20or%20Harmonized%20audit.
33. Climate Smart Agriculture Program (CSAP)
    - OCPC Eligible Entities: All agricultural growers/operators
    - Eligible projects: Projects that help the agricultural sector reduce vulnerability to expected impacts from climate change (adaptation), reduce emissions or sequester carbon (mitigation), and projects that safeguard the Commonwealth's natural resources. Proposals including, but not limited to, projects that improve soil health, improve water use efficiency and availability, promote efforts to reduce or limit greenhouse gas emissions, enhance greenhouse gas sequestration, improve energy efficiency and facilitate clean energy adoption will all be considered.
    - Funding: Grant. Max award $50K. 20% match required. ACRE- Agricultural Climate Resiliency & Efficiencies Grant, AEEP- Agricultural Environmental Enhancement Program Grant, and ENER- Agricultural Energy Grant
    - https://www.mass.gov/how-to/how-to-apply-to-the-climate-smart-agriculture-program
34. Farm Financial Assistance Programs
    - OCPC Eligible Entities: Varies by program (Cranberry bogs, farms, and food companies, etc.)
    - Eligible projects: Cranberry Renovation Tax Credit Program, Dairy Farmer Tax Credit Program, Farm Energy Discount Program, GAP/GHP Reimbursement, Organic Cost Share, Rollover Protective Structure Retrofit Program,
    - Funding: varies by program.
    - https://www.mass.gov/guides/agricultural-grants-and-financial-assistance-programs

35. MA Agricultural Grants
    - Farm Improvement Grants, Grants for New Farms, Grants to Improve Food Access, Marketing and Promotion Grants, Agriculture Preservation Restriction Program, Agricultural Composting Improvement Program, Cranberry Bog Renovation Grant Program, Agricultural Cranberry Enhancement Program
    - OCPC Eligible Entities: Varies by program (Cranberry bogs, farms, and food companies, etc.)
    - https://www.mass.gov/guides/agricultural-grants-and-financial-assistance-programs
36. Foundation for Food & Agriculture Research (FFAR)
    - OCPC Eligible Entities: U.S. institutions of higher education, nonprofit and for-profit organizations, government-affiliated researcher and domestic and international organizations
    - Eligible projects: varies by program. Projects support research in the fields of food security, agriculture, and sustainability.
    - https://foundationfar.org/grants-funding/
37. Massachusetts' Gap Energy Grant Program
    - OCPC Eligible entities: All municipalities, nonprofit multifamily affordable housing organizations, nonprofit agricultural/food producing organizations, and small businesses engaged in food distribution and processing
    - Eligible projects: energy efficiency (i.e. pump and motor replacements, process improvements), clean energy (i.e. renewable energy generation, energy storage)
    - https://www.mass.gov/info-details/massachusetts-gap-energy-grant-program#news-and-announcements

Appendix I Additional Details for Recommended Strategies

Appendix I Additional Details for Recommended Strategies

I.1 Strategy B: Introduce Policies and Regulations to Reduce the Waste of Water and Improve Ecosystem Health

I.1.1 Native Landscaping Education and Potential Local By-Laws

Plants native to the region have adapted to local climate conditions and require less water than non-native plants. Native landscaping has many additional co-benefits, such as requiring less fertilizer which helps reduce impacts to water quality, storing water in deep root systems which helps reduce runoff and control erosion, maintaining native biodiversity, providing habitat for birds and other animals.

List of Plants Native to South Shore Massachusetts

To support the implementation of this strategy, CDM Smith has prepared lists of plants native to the OCPC region, including evergreen trees in **Table I.1**, deciduous trees in **Table I.2**, shrubs in **Table I.3**, and perennials and grasses **Table I.4**. Two resources were used to compile these tables, the Massachusetts Native Plant Palette and the book *Vascular Plants of Massachusetts* (MA Water Resources Commission 2024, Cullina and Connolly 2012). The tables include the botanical name, the common name, along with the plant's water needs, drought tolerance, hardiness zones, and impact of climate change to the plant's health. Some descriptions of these items are included.

Water needs can vary by plant. Typically, a plant that requires dry soil does not need any supplemental water once established and will thrive in soil that is well drained. Plants that require wet soil thrive best in consistent moisture. They live well in wetland/wetland edge or bioretention type habitats, or they may need to be watered weekly depending on rainfall. Plants with "Medium" water needs will need supplemental watering, but only on hot days or weeks with excessive dry periods. The column "water needs" in the table indicates these different water needs for each plant.

Drought tolerance indicates plants that can withstand extended periods of time with minimal or zero rainfall. This can be due to a myriad of adaptations such as they can shade themselves, trap water inside, or can harvest moisture through the air. Many plants denoted as "Drought Tolerant" can withstand a wide range of growing conditions and require little supplemental watering once established.

A hardiness zone is a geographic area with its own range of climatic and more specifically, temperature, conditions. Defined by the average minimum temperature of each region, the lower the hardiness zone number, the colder the climate. The south shore of Massachusetts is partially in Hardiness Zone 6b and partially in Zone 7a implying a minimum temperature range of –5 – 0 degrees Fahrenheit and 0 – 5 degrees Fahrenheit. Parts of Western Massachusetts are colder with hardiness zones of 6a and 5b, while Cape Cod and the Islands of Martha's Vineyard and Nantucket get up to Zone 7b. As climate change continues, warmer hardiness zones will continue to move north, affecting what plants can grow best in each region.

The United States Forest Service created a Climate Change Tree Atlas to predict how certain tree species will fare under climate change (United States Forest Service, 2024). Through extensive scientific modeling, they measured habitat suitability and migration potential under both a best and worst-case-scenario climate change to see what trees would be able to colonize new areas or survive in their current habitat. They also looked at resistance to disturbance events such as pests or fire as factors. These efforts are combined to create an "Adaptability Score" which informs whether the species will fare better or worse under climate change. This analysis was not available for shrubs and perennials and grasses.

Table I.1: List of Evergreen Trees Native to the OCPC Region

Botanical Name	Common Name	Water Needs	Drought Tolerance	Hardiness Zones	Impact Of Climate Change To Plant's Health
Chamaecyparis thyoides	Atlantic White Cedar	Medium	Y	4-8	
Juniperus communis	Common Juniper	Medium	Y	2-7	
Juniperus virginiana	Eastern Red Cedar	Dry to medium	Y	2-9	Better
Picea mariana	Black Spruce	Medium to Wet	N	3-6	
Pinus rigida	Pitch Pine	Medium	N	3-8	Worse
Pinus strobus	White Pine	Medium	N	3-8	Worse
Thuja occidentalis	Arborvitae	Medium	N	2-7	
Tsuga canadensis	Eastern Hemlock	Medium	N	3-7	Worse
Taxus canadensis	American Yew	Medium	N	3-7	

Table I.2: List of Deciduous Trees Native to the OCPC Region

Botanical Name	Common Name	Water Needs	Drought Tolerance	Hardiness Zones	Impact Of Climate Change To Plant's Health
Acer rubrum	Red Maple	Medium to Wet	N	3-9	worse
Betula alleghaniensis	Yellow Birch	Medium to Wet	N	3-7	better
Betula papyrifera	Paper Birch	Medium to Wet	N	2-6	worse
Betula populifolia	Gray Birch	Medium to Wet	N	3-6	better
Carya cordiformus	Bitternut Hickory	Medium to Wet	N	4-9	Better
Carya glabra	Pignut Hickory	Medium	N	4-9	Better
Carya tomentosa	Mockernut Hickory	Medium	N	4-9	Better
Carpinus caroliniana	American Hornbeam	Medium	N	3-9	Better
Celtis occidentalis	Common Hackberry	Medium to Wet	Y	2-9	
Cornus florida	Flowering Dogwood	Medium	N	5-9	
Crataegus crus-galli var. inermis	Thornless Cockspur Hawthorn	Medium	Y	3-7	
Fagus grandifolia	American Beech	Medium	N	3-9	Better
Nyssa sylvatica	Black Tupelo	Medium to Wet	N	3-9	Better
Ostrya virginiana	Hop Hornbeam	Medium	Y	3-9	Better

Botanical Name	Common Name	Water Needs	Drought Tolerance	Hardiness Zones	Impact Of Climate Change To Plant's Health
Prunus virginiana	Chokeberry	Dry to Medium	Y	2-7	
Quercus alba	White Oak	Dry to Medium	Y	3-9	Better
Quercus palustris	Pin Oak	Medium to Wet	N	4-8	Better
Quercus rubra	Red Oak	Dry to Medium	Y	4-8	Worse
Salix nigra	Black Willow	Medium to Wet	N	4-9	Worse
Sassafras albidum	Sassafras	Medium	Y	4-9	Better
Ulmus americana	American Elm	Medium	Y	2-9	

Table I.3: List of Shrubs Native to the OCPC Region

Botanical Name	Common Name	Water Needs	Drought Tolerance	Hardiness Zones
Amelanchier canadensis	Serviceberry	Medium	N	4-8
Arctostaphylos uva-ursi	Bearberry	Dry to Medium	N	2-7
Aronia arbutifolia	Red Chokeberry	Medium	N	4-9
Aronia melanocarpa	Black Chokeberry	Medium	N	3-8
Ceanothus americanus	New Jersey Tea	Dry to Medium	Y	4-8
Cephalanthus occidentalis	Buttonbush	Medium to Wet	N	5-9
Clethra alnifolia	Sweet Pepperbush	Medium to Wet	N	3-9
Comptonia peregrina	Sweet fern	Medium	Y	2-6
Cornus amomum	Silky Dogwood	Medium to Wet	N	5-8
Cornus racemosa	Gray Dogwood	Medium	N	4-8
Cornus rugosa	Round-leaved Dogwood	Dry to Medium	N	3-6
Corylus americana	American Hazelnut	Medium	N	4-9
Corylus cornuta	Beaked Hazelnut	Medium	N	4-8
Diervilla lonicera	Bush-honeysuckle	Dry to Medium	Y	3-7
Eubotrys racemosa	Swamp Sweetbells	Medium to Wet	N	5-9
Ilex glabra	Inkberry	Medium to Wet	N	4-9
Ilex verticilata	Winterberry	Medium to Wet	N	3-9
Juniperus communis	Common Juniper	Medium	Y	2-7
Juniperus horizentalis	Creeping Juniper	Medium	Y	3-9
Kalmia latifolia	Mountain Laurel	Medium	N	4-9
Lindera benzoin	Spicebush	Medium	Y	4-9
Morella pensylvanica	Bayberry	Dry to Medium	Y	3-7
Myrica gale	Sweet Gale	Medium to Wet	N	2-6
Potentilla fruticosa	Shrubby Cinquefoil	Medium	Y	3-7
Prunus pumila var. depressa	Swarf Sand cherry	Dry to Medium	Y	3-7
Rhus typhina	Staghorn Sumac	Dry to Medium	Y	3-8
Rosa virginiana	Virginia Rose	Dry to Medium	N	3-8

Botanical Name	Common Name	Water Needs	Drought Tolerance	Hardiness Zones
Sambucus canadensis	Black Elderberry	Medium to Wet	N	3-9
Spiraea tomentosa	Rosy Meadowsweet	Medium to Wet	N	3-8
Vaccinium angustifolium	Lowbush Blueberry	Medium	N	2-8
Vaccinium corymbosum	Highbush Blueberry	Medium to Wet	N	5-8
Vaccinium stamineum	Deerberry	Medium	Y	5-9
Viburnum acerifolium	Maple-Leaved Viburnum	Medium	N	3-8
Viburnum cassinoides	Wild Raisin	Medium to Wet	N	3-8
Viburnum dentatum	Smooth Arrowwood	Medium	N	2-8
Viburnum lantanoides	Hobblebush	Dry to Medium	Y	4-7
Viburnum trilobum	Cranberrybush Viburnum	Medium	N	2-7

Table I.4: Perennials and Grasses Native to the OCPC Region

Botanical Name	Common Name	Water Needs	Drought Tolerance	Hardiness Zones
Achillea millefolium	Yarrow	Dry to Medium	Y	3-9
Aquilegia canadensis	Red Columbine	Medium	Y	3-8
Asclepias tuberosa	Butterfly Milkweed	Dry to Medium	Y	3-9
Baptisia tinctoria	Yellow Wild Indigo	Dry to Medium	Y	3-9
Campanula rotundifolia	Scotch Bellflower	Medium	N	3-6
Coreopsis rosea	Pink Tickseed	Medium	N	3-8
Eutrochium maculatum	Spotted Joe-Pye Weed	Medium to Wet	N	4-8
Eupatorium perfoliatum	Boneset Thoroughwort	Medium to Wet	N	3-8
Eupatorium purpereum	Joe-Pye Weed	Medium	N	4-9
Eurybia macrophylla	Large-Leaved Wood Aster	Medium	N	3-8
Geranium maculatum	Wild Geranium	Medium	Y	3-8
Ionactis linarifolia	Stiff Aster	Dry to Medium	Y	4-9
Lilium superbum	Turk's Cap Lily	Medium to Wet	N	5-8
Lobelia cardinalis	Cardinal Flower	Medium to Wet	N	3-9
Lupinus perennis	Sundial Lupine	Dry	Y	3-8
Monarda fistulosa	Wild Bee-Balm	Dry to Medium	Y	3-9
Monarda punctata	Spotted Bee-Balm	Dry to Medium	Y	3-8
Pycnanthemum virginianum	Clustered Mountain Mint	Medium	N	3-7
Pycnanthemum tenuifolium	Narrow-Leaved Mountain Mint	Dry to Medium	Y	4-8
Rhexia virginica	Northern Meadowbeauty	Medium to Wet	N	4-8
Solidago bicolor	Silverrod	Dry to Medium	Y	5-10
Solidago caesia	Wreath Godenrod	Dry to Medium	Y	4-8
Solidago nemoralis	Gray Goldenrod	Dry to Medium	Y	3-9
Solidago odora	Sweet Goldenrod	Dry to Medium	Y	4-9
Solidago puberula	Downy Goldrenrod	Dry to Medium	Y	3-9

Botanical Name	Common Name	Water Needs	Drought Tolerance	Hardiness Zones
Solidago sempervirens	Seaside Goldenrod	Dry to Medium	Y	3-10
Verbena hastata	Blue Vervain	Medium to Wet	N	3-8
Vernonia noveboracensis	New York Ironweed	Medium to Wet	N	5-9
Viola pedata	Birdsfoot Violet	Dry to Medium	Y	4-8
Zizia aurea	Common Golden alexanders	Medium	N	3-8
Andropogon gerardii	Big Blue-stem	Dry to Medium	Y	4-9
Carex eburnea	Blue-leaf Sedge	Medium	N	2-8
Carex pensylvanica	Pennsylvania Sedge	Dry to Medium	N	3-8
Juncus tenuis	Path Rush	Medium to Wet	N	2-9
Schizachyrum scoparium	Little Blue Stem	Dry to Medium	Y	3-9

I.1.2 Examples of Related Bylaws Passed in New England

To support with the development of language for local native landscaping bylaws, CDM Smith has included examples of local bylaws passed by other municipalities in New England. These can be used as guides for developing local ordinances in the OCPC Region. In addition, Mass Audubon has created a Bylaw Review tool to help evaluate current regulations, allowing you to understand the best practices already in place within your community and identify areas for improvement.[1] This tool can be valuable in the process of developing or updating such bylaws.

- **Somerville Massachusetts, City of Somerville Ordinance No. 2021-05, March 2021**
  "All new plantings shall consist of native plants only in Riparian areas, The community path, The green line extension rail corridor, bioswales, plaza's, streetscapes, and other city-owned properties. A minimum of 75% native plantings in parks. A minimum of 50% native street trees planted by the city each year to increase in subsequent years."
- **Ridgefield Connecticut, Town of Ridgefield Policy on the Use of Native Plants on Town- Owned Property, September 2022**
  "100% of new and replacement trees, shrubs, herbaceous perennials, and ground cover plantings on municipal properties will be native to the Northeast. The policy also applies to any replacement plantings, including but not limited to trees, shrubs, and perennials felled by storms, disease, redevelopment/expansion, or other reasons. The policy also applies to seeds."
- **Newtown Connecticut, Town of Newtown, Text Amendments to Town of Newtown Zoning Regulations - Article VIII Supplemental Regulations, Section 4 - Landscape, Screening and Buffer Requirements, December 202**
  "A minimum *standard requirement for all new plantings of trees, shrubs and other plants on municipal properties. It also applies to seeds used in place of plants. The policy applies to any replacement plantings, including but not limited to trees, shrubs, and perennials felled by storms, disease, redevelopment/expansion, or other* reasons. *New and replacement plantings for trees, grasses and ground covers must be 100% native. New and replacement plantings of shrubs must be 85% native. New and replacement plantings of herbaceous perennials must by 75% native."*

It is important to note that these ordinances carry exceptions (e.g., growing food in gardens and green roofs). It is recommended that exceptions be evaluated in the OCPC region where appropriate.

I.2 Nonessential Water Use Restrictions for Municipalities with Registration and Private Well

This will encourage sustainable water use and standard restrictions across all water users in a community whether they are on private wells versus on public water supply. Many communities in the OCPC region already have restrictions on outdoor water use for their public water systems through their WMA permit. This recommendation would be relevant to the communities that do not have a permit.

The Massachusetts Department of Environmental Protection (MassDEP) Water Management Act Program has publicly available guidance to help municipalities implement seasonal conservation of water supplied by public water systems, as well as private wells and in-ground irrigation systems.[1] The Outdoor Water Use Model Bylaw with Options (revised 2018) includes language related to including private well users in the outdoor water use restrictions. For OCPC communities interested in passing these restrictions, this resource should be leverages.

I.2.1 Examples of Related Bylaws Passed in New England

Some examples local bylaws passed by other municipalities in Massachusetts are included. To ensure appropriate specificity, the model bylaw developed by DEP should be leveraged, but these examples are included for additional context.

Stow, Massachusetts, Stow Board of Health, Outdoor Water Use Restrictions for Private Wells (DRAFT)[2]

> *"During a Drought Condition affecting any area or region of which the Town of Stow is a part, as declared the Secretary, nonessential water use shall be limited as set forth in the Table below. Notwithstanding any action or in-action by the Secretary, the Board of Health may declare a Drought Condition for the Town of Stow and establish limitations on nonessential water use; provided that any restrictions on nonessential water use declared by the Board shall be at least as restrictive (but may be more restrictive) as the restrictions mandated by the Secretary."*

The referenced table in this ordinance is included (**Table I.5**).

[1] https://www.mass.gov/info-details/model-water-use-restriction-bylawordinance-update

[2] https://www.stow-ma.gov/sites/g/files/vyhlif11851/f/news/boh_outdoor_use_restrictions_for_private_wells_draft.pdf

Table I.5: State Guidance on Nonessential Outdoor Water-Use Restrictions at Various Drought Levels

State Drought Condition (by Region)	Nonessential Outdoor Water-Use Restrictions
Level 1 (Mild Drought)	1 day per week watering, after 5 p.m. or before 9 a.m. (to minimize evaporative losses)
Level 2 (Significant Drought)	Limit outdoor watering to hand-held hoses or watering cans, to be used only after 5 p.m. or before 9 a.m.
Level 3 (Critical Drought)	Ban on all nonessential outdoor water use
Level 4 (Emergency Drought)	Ban on all nonessential outdoor water use

Ipswich Massachusetts, Town of Ipswich, Article II Outdoor Water Use[3]

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

I.3 Water Demand Offset Policies

This strategy includes details on water demand offset policies, which focus on reducing water use from new development. Water demand offset policies require action on the part of developers to ensure that the new development does not result in an increase in overall water withdrawal. Rules for what qualifies as a demand offset will vary by municipality but could include practices such as installation of rainwater or stormwater recovery. There are various ways a municipality can design and implement a policy to achieve this. Alliance for Water Efficiency provides copious resources for the development and implementation of water-neutral growth policies through their Net Blue initiative,[4] including a research report describing communities with water-neutral policies currently in place (Christiansen 2015).

Some typical exemptions included for these water demand offset policies include public schools and municipal projects. It is recommended that OCPC communities coordinate on these policies, including a provision that the bylaw not take effect until a certain number of other OCPC communities bylaws have also passed. This will allow for negative impacts, such as developers being concerned about coming into a community with restrictions that the neighboring communities doesn't have, to be mitigated.

[3] https://www.ipswichma.gov/DocumentCenter/View/9576/Water-Restriction-By-Law-ADOPTED-MAY-2017

[4] Net Blue: Supporting Water-Neutral Growth | Alliance for Water Efficiency

I.3.1 Examples of Related Bylaws Passed in Massachusetts

To support the development of language for water demand offset polies, CDM Smith has included examples of local bylaws and programs suggested or passed by other municipalities in Massachusetts. These can be used as guides for developing local ordinances in the OCPC Region.

Town of Ipswich MA, Model Water Use Mitigation Bylaw, October 2020[5]

> *"An application concerning development within The Town of Ipswich that would use water from the Ipswich public water supply shall not be approved if the proposed development would increase water use on the property, unless the applicant offsets the requisite amount of water demand via one or more of the methods in this bylaw."*

Town of Weymouth, Water Conservation Measures[6]

> *"Any new water use applications issued by the Town are required to complete a 2:1 water savings ratio. These savings may be gained through the retrofitting of existing buildings with water savings devices. The retrofitting of all public buildings, schools, and some businesses and residences has been accomplished with the cooperation of the Town, new users, and contractors. These projects include the furnishing and installation of low flow toilets, low flow showerheads, low flow faucets, and low flow flushometers."*

Town of Hingham MA, Water Balance Program[7]

> *"The Water Balance Program applies to all new and expanded water use projects, except (1) residential development with only a single service connection and (2) new and/or expanded water use developments that are expected to require less than 100,000 gallons per year of water. Applicants will have several options including:*
>
> 1) *Applicant-Directed Conservation – Applicant identifies and implements water conservation activities through retrofits approved by the Weir River Water System.*
>
> 2) *Water Banking – Applicant provides funding for a Water Bank that will be used by the Weir River Water System to fund conservation efforts.*
>
> 3) *Supplemental Source of Water Supply – (1) The Applicant identifies and develops a supplemental source of supply for the Weir River Water System and (2) the Applicant finances the development of a supplemental source of supply."*

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[5] https://www.ipswichma.gov/DocumentCenter/View/12312/Water-Neutral-Growth-Plan---May-2020

[6] https://www.weymouth.ma.us/water-sewer/pages/water-system#:~:text=In%20the%20past%20several%20years,buildings%20with%20water%20savings%20devices

[7] https://www.hingham-ma.gov/883/Water-Balance-Program

I.4 Water Use Mitigation Programs

One specific type of water demand offset policy is a Water Use Mitigation Program (WUMP). With a WUMP, also known as a water bank, the community collects a fee for each new development which must exclusively be used for conserving water resources, reducing demand upon the public water supply, and/or water use mitigation.

A water bank is technically defined in the 2018 Massachusetts Water Conservation Standards as "… a system of accounting and paying for measures that offset existing water use or mitigate water losses. The primary goals of a water bank are to offset the impacts of new demand to help pay for measures that balance the water budget, reduce water losses, increase water efficiency, reduce discretionary water use and keep water local" (EEA and MWRC 2018). MassDEP has the authority to require a WUMP (MassDEP 2023).

Under a typical WUMP, the water supplier is responsible for the administration and execution of water mitigation projects. The funds collected can also be used on water conservation education or to defray salary and administration costs.

The adoption of this program is especially recommended for communities who are anticipating substantial future development and are concerned about being able to meet increased drinking water demands.

The WUMP program is applicable to projects that typically fall under one or more of the following categories:

- Projects that require a building permit
- Projects that represent a new or increased water demand
- Residential project of (3) or more dwelling units
- All commercial projects

I.4.1 Examples of Related Programs Passed in Massachusetts

To support the development of a WUMP, CDM Smith has included examples of local WUMPs fee structures adopted by other municipalities in Massachusetts. These can be used as guides for developing local WUMP's in the OCPC Region.

Town of Danvers[8]

> *"The Danvers WUMP has been implemented in according with requirements set forth by the MassDEP in the Town's WMA Permit. The Town of Danvers is required to collect a fee to fund water savings projects sufficient to mitigate new water demand by a 2:1 rate."* Danvers' example fee structure is outlined in **Table I.6**.

[8] https://www.danversma.gov/DocumentCenter/View/468/Water-Use-Mitigation-Program-Policy-PDF

Table I.6: Town of Danvers Water Use Mitigation Charges

Development Type	Fee
Residential – 1 Bedroom	$ 1,980/unit
Residential – 2 Bedroom	$ 3,960/unit
Residential – 3 Bedroom	$ 5,940/unit
Residential – 4 Bedroom	$ 7,920/unit
Commercial and Industrial	$9.00/gpd (Gallon per day volume defined per Title 5)

Town of Ipswich[9]

> *"The following Water Use* Mitigation *Program (WUMP) is implemented to mitigate water demand of new developments to minimize impacts to the water system. The funds collected through this program will fund water saving projects to enable the public water system to meet the additional demand*." Ipswich's example fee structure outlined in **Table I.7**.

Table I.7: Town of Ipswich Water Use Mitigation Charges

Development Type	Fee
Residential	$ 1,500/Bedroom
Non-Residential	$ 13.50/gpd (Gallon per day volume defined per Title 5)

Town of Wenham[10]

> *"The Wenham Water Use Mitigation Program [WUMP] has been implemented to collect a fee to fund water savings projects to mitigate new water demand."* Wenham's example fee structure outlined in **Table I.8**.

Table I.8: Town of Wenham Water Use Mitigation Charges

Development Type	Fee
Residential – 1 Bedroom	$ 550/unit
Residential – 2 Bedroom	$ 1,100/unit
Residential – 3 Bedroom	$ 1,650/unit
Residential – 4 Bedroom	$ 2,200/unit
Commercial and Industrial	$5.5/gpd/unit (Gallon per day volume defined per Title 5)

[9] https://www.ipswichma.gov/DocumentCenter/View/12583/Interim-Water-Use-Mitigation-Program-ADOPTED-10-5-20

[10] https://cms4files1.revize.com/wenhamma/WUMP_Policy%203.26.19.pdf

I.5 Strategy K: Conduct an Integrated Ecological Assessment and Pursue Improvements

Ecosystem assessment can take many forms, but it most commonly involves documenting factors that affect the health and functioning of natural ecosystems. This is typically done at a watershed or sub-watershed scale and includes examining land use changes, water quality, habitat fragmentation, the spread of invasive species, restoration of species in decline, and overall biodiversity levels. These assessments provide a comprehensive overview of the ecosystem's current state, enabling conservationists to identify key threats and prioritize areas for intervention. By evaluating these factors, ecosystem assessments are critical for targeting conservation efforts, setting goals for ecosystem health, and ensuring the resilience of natural systems in the face of environmental change.

One important metric derived from an ecosystem assessment is ecological flow need (EFN). EFN refers to the amount, quality, and timing of water flows necessary to sustain the health of river ecosystems while also supporting sustainable human development. Understanding EFN is crucial for maintaining biodiversity and advancing sustainable development, as many aquatic and riparian species rely on specific flow conditions for breeding, feeding, habitat connectivity and population stability. In the Jones River, species such as American eels, native trout, sea run, shad, river herring populations must be considered.

Numerous approaches have been developed to define EFN for specific watersheds and regions across multiple spatial scales, often involving hydrological modeling, ecological studies, and stakeholder engagement to ensure that the needs of both ecosystems and communities are addressed. The Massachusetts Department of Conservation and Recreation (DCR) reviewed various standard-setting instream flow methods and created their own Index Streamflow Statistics to represent the characteristics of natural streamflow in Massachusetts (DCR, 2008). The Index Streamflow documentation presents three different sets of statistics for benchmarking streamflow:

- Annual Target Hydrograph: This method uses monthly quartile flows to describe natural flow patterns throughout the year, serving as a standard for managing streamflow in the absence of site-specific data.
- Aquatic Base Flow (ABF) Approach: This method focuses on the median of monthly mean flows, providing a critical benchmark for low-flow conditions necessary to sustain aquatic habitats.
- Indicators of Hydrologic Alteration (IHA) Statistics: This group of statistics represents various aspects of streamflow, including magnitude, duration, frequency, and rate of change, helping to identify deviations from natural flow regimes.

In addition to the Index Streamflow Statistics, MassDEP partnered with the U.S Geological Survey (USGS) to develop the Massachusetts Sustainable-Yield Estimator. MAYSE is a planning-level decision-support tool designed to help decision-makers estimate daily mean streamflow and selected streamflow statistics that can be used to assess sustainable water use at ungauged sites in Massachusetts.

I.5.1 Activities for Consideration

Potential activities for the Old Colony region include:

- Consult with a professional freshwater fisheries expert
- Oversee the establishment of ecological flow needs in the three sub-watersheds (North River, Taunton headwater, Jones River)
- Develop and gain regional agreement to EFN benchmark methods
- Conduct modeling to establish EFN Targets
- Evaluate built environment (culverts, dams, diversions) within their respective sub-watersheds and along stream networks and their hydrologic relationship to the downstream resources
- Assess EFN gaps and opportunities for improvement
- Identify the presence of ecological, hydrological, and/or socioeconomic characteristics and management options to enhance, maintain, and/or restore EFN. Look for intersections to identify projects or clusters of projects where multiple benefits can be realized.
- Establish a prioritized list of recommended improvements as well as obstacles to their implementation

I.5.2 Lake and Reservoir Management Strategies

The goal of surface water management is to optimize the use of water stored in lakes and ponds by balancing multiple competing needs, including water supply, flood control, recreation, and environmental health. The two communities in the Old Colony region that draw supply from surface waters are Brockton and Abington.

Abington draws water from the Great Sandy Bottom Pond and Hingham Street Reservoir and the town may face challenges in meeting water demands by 2025 based on some projections (H2Olson 2022). Surface water management strategies, which are being developed with the help of funding from the MassDEP (MassDEP 2023), can help optimize water supply and ensure future needs are met.

Example surface water management strategies might include:

- Optimal Withdrawals Operations: Timing water withdrawals between multiple surface water sources to maximize supply while minimizing environmental impact.
- Trigger-Based Management: Using lake levels and downstream streamflow as a trigger for operational decisions, such as when to increase or reduce water withdrawals.
- Integrated Surface Water Modeling: Abington is developing an integrated reservoir model to forecast supply and demand, helping the town plan for future needs by simulating different scenarios and management strategies.
- Consider Climate Impacts: The Old Colony Regional Water Plan suggests that natural water may be more plentiful in the future. Consider a vulnerability/opportunity study that could advise surface water management decisions based on plausible or likely long-term climate trends.

Brockton faces challenges in managing Silver Lake and Monponsett Pond to provide reliable and safe drinking water, a healthy aquatic lake environment, and downstream flows for ecological needs. It is a good example of why this strategy focuses on integrated assessment of ecological flow needs, surface water management alternatives, and reduced fish passage impediments. Current MassDEP regulations dictate that diversions into Silver Lake from Monponsett Pond must be limited to the months of October through May to minimize nutrient influx and manage lake levels. However, challenges remain, including ongoing water quality issues and low-flow conditions preventing juvenile herring from exiting the lake. Several reports have been published with strategies on how to manage flows and loads in Silver Lake, including a 2013 Sustainable Water Management Initiative (SWMI) Monponsett Pond and Silver Lake Water Use Operations and Improvement Report (Princeton Hydro) and the Silver Lake Water Quality Monitoring Program Report (TRC 2023).

As part of its Comprehensive Water Management Plan, and potentially as a factor in the outlined integrated assessment below, Brockton could consider alternative flow management strategies, though it is understood that they must comply with regulations and support allowable use of drinking water. Several example surface water management options (not considered strategies at this time) that could be considered to enhance surface water management further include:

- Divert Flood Waters: Redirecting flood waters from Monponsett Pond to nearby wetlands could reduce the amount diverted into Silver Lake.
- Pre-Treatment of Diversions: Implementing pre-treatment measures for diversions from Monponsett into Silver Lake could reduce nutrient loading and improve water quality.
- Reduce Withdrawals: Decreasing withdrawals from Silver Lake, either year-round or specifically during the summer months, can alleviate pressure on the lake and support ecological needs. This may only be possible with aggressive demand management and/or water offsets associated with more utilization of the desalination plant.
- Evaluate Diversion Months: Evaluate scenarios with different diversions timings to better align with ecological flow requirements and water quality goals. This would require close collaboration with MassDEP, and a better understanding of natural flow and constructed impediments.

I.5.3 Identification and Removal of Migratory Impediments

River herring populations are at historically low levels due to a combination of factors, including dam construction, habitat loss, degradation, and overfishing. Dams and infrastructure that obstruct fish movement (both into and out of spawning waters) have significantly contributed to this decline, alongside challenges like poor water quality and temperature changes linked to climate change

Herring are migratory species that spend most of their lives in marine environments but migrate into freshwater systems to spawn. Their presence is vital to the food web, and they hold deep cultural significance for indigenous communities, such as the Herring Pond Wampanoag Tribe. For these communities, herring are not only a crucial source of sustenance but also play an important role in spiritual practices. The herring's upstream journey to spawn marks the beginning of the new year in spring.

Many barriers impede the migration of diadromous species, including dams and culverts. Some of these structures, built in the 1700s and 1800s for milling, are now in disrepair and not equipped to handle increased rainfall from climate change, raising flood risks for surrounding human populations. The decision to remove or modify these barriers is complex and requires careful evaluation of ownership, public water supply needs, floodplain restoration, and community support.

Various government and non-profit organizations have been actively working to remove redundant dams and restore herring habitats. One of the more complex restoration efforts in the Old Colony area has focused on reconnecting fish to significant spawning and nursery habitats, such as Monponsett Pond, Silver Lake, and Furnace Pond. The fact that these and other water bodies also serve as drinking water sources contributes to the complexity of providing suitable ecological flows at the right times of year.

Efforts to integrate the removal of migratory obstacles into future planning and development projects in the region should continue, working collaboratively with organizations like the North and South Rivers Association and the Jones River Watershed Association to restore fish passage and enhance local ecosystems effectively. Additionally, mill dams throughout the watershed that are decommissioned or otherwise obsolete may be considered candidates for removal or improved fish passageways, provided detailed Environmental Impact Assessments and all other regulatory procedures are followed.

I.5.4 Example Framework for Integrated Assessment

The framework for this recommended assessment is envisioned to be more reliant on data collection and interpretation than on modeling or dynamic analysis, though the latter should not be precluded from consideration. It could begin by defining idealized goals for a healthy balance between consumptive and non-consumptive uses of water, proceed through data analysis and clarification of actual flexibilities, and conclude with an assessment of what might actually be feasible for improving this balance at the three locations identified (Silver Lake / Jones River, Monponsett Pond / Stump Brook / Furnace Pond, and Great Sandy Bottom Pond). The following outline is offered as an example study framework:

Step 1: What would a better balance look like? Idealization of goals and their desired rates of achievement for multiple water uses (enough water of sufficient quality at the right times to support public and environmental health). This could involve consultation from aquatic ecologists, water quality experts, utility managers, regulatory officials, etc. It could also include the analytical methods described above to estimate the Environmental Flow Need.

Step 2: How often have these ideal goals been historically realized? In full or in part, how often does the data suggest multiple goals have been realized independently and concurrently in the past 30 years?

Step 3: Data Relationships and Projections: Can we identify or infer links between natural flows, managed flows, residence time, water quality, ecological conditions, etc.? Can we estimate whether perceived imbalances may get better or worse naturally as a function of climate variability? (Modeling may be useful in this analysis, but at a minimum, data should be mined for explanatory and instructional relationships.)

Step 4: Management variables: What options are available to improve natural flows at critical times, water quality in streams and lakes, drinking water reliability and viability, etc.? These could be infrastructure investments/modifications, alternative operating rules, in situ water body treatment, etc. How flexible are existing infrastructure and regulations to enact these options? What are the physical, regulatory, climatic, financial, institutional, political, and other limitations? Suggestions for management alternatives are included in the narratives above.

Step 5: Experimental Tradeoff and Sensitivity Analysis: From the management variables that may be feasible, is there enough meaningful and feasible flexibility to create tradeoffs that can be considered beneficial and/or acceptable for multiple water uses?

Step 6: Implementation feasibility: What impediments might exist toward improving the balance between consumptive and non-consumptive water uses (cost, regulations, political will, risks, etc.)?

Step 7: Water Management Strategies What could a better balance look like? Based on the progression of explorations, are there ways to realize more sustainable and balanced benefits between multiple water uses?

Appendix J Analysis of Future Offsets to Silver Lake Withdrawals

Memorandum

To: *Old Colony Planning Council*

From: *Amara Regehr and Kirk Westphal*

Date: *March 31, 2025*

Subject: *Supplemental Analysis of Future Offsets to Silver Lake Withdrawals*

Supplemental Analysis of Future Offsets to Silver Lake Withdrawals

Historically, drawdown of Silver Lake to provide water supply for the City of Brockton and others can contribute to water levels dropping below the crest of a berm which is upstream of the Forge Pond dam, and approximately 1.5 feet below Forge Pond dam's spillway. The physical configuration of the berm can therefore prevent downstream release of water to support fish passage into and out of Silver Lake. Figure 1 illustrates the physical configuration of the dam, the berm, and the water surface of Silver Lake. This analysis seeks to determine if a key strategy emerging from the Old Colony Planning Council's (OCPC) Regional Water Plan could help increase the potential for downstream water releases during critical months to better support fish passage.

One key recommendation in the OCPC Regional Water Plan is expanding the use of the Aquaria desalination plant to support a diversification of clean drinking water supply sources for the region. If the City increases use of water from the desalination plant, there is the opportunity to offset some of the water Brockton uses for drinking water from Silver Lake and increase the volume retained within Silver Lake. This analysis seeks to estimate the potential increase in number of days per year that could result in an opportunity for water release to the Jones River to support fish passage and determine if this change could be significant compared with historical conditions.

This memorandum outlines the methodology used to assess the potential days for which there is an opportunity for water release downstream for different operational scenarios and presents the results of the analysis.

Methodology

This section outlines the methodology used to assess the potential increase in days for which there could be an opportunity for water release downstream of Silver Lake. The analysis considered three scenarios where Brockton requests different flow rates of drinking water from the desalination plant, reducing the amount withdrawn from Silver Lake via the Silver Lake Water Treatment Plant:

- 1.0 MGD from Aquaria desalination plant
- 1.5 MGD from Aquaria desalination plant
- 2.0 MGD from Aquaria desalination plant

These flow rates are assumed to be maintained per day within Silver Lake. The data sources used for this analysis are shown in **Table 1**.

Table 1 Data Sources

Description	Source
Historic daily water levels in Silver Lake	Brockton Department of Public Works
Historic daily use of Aquaria desalination water	Brockton Department of Public Works
Stage-storage relationship	Bathymetric contours from Coler and Colantonio 2003
Elevations of Forge Pond Dam and berm	Existing Conditions Survey by Dawood, completed December 13, 2024
Critical periods for diadromous fish migration	Email exchange with Department of Marine Fisheries

This analysis did not model the lake or its outflow. Instead, it examined the potential increase in water surface elevation that could have resulted under historical hydrologic and operational conditions by computing the accumulation of water in the lake that would have been offset by water sourced from the desalination plant.

To estimate the changes to water surface elevation in Silver Lake, it is important to understand the physical constraints in place to control water release from Silver Lake. Silver Lake is hydraulically connected to Forge Pond, with a berm crest between the two water bodies reaching elevation 45.1 feet (NAVD88) (Dawood 2024). In addition to the berm crest, Forge Pond Dam prevents release of waters from Silver Lake, with water needing to be above elevation 45.1 feet (NAVD88) to be able to be released from the dam's release gates. Water will also release over the dam spillway once water surface elevations exceed 46.6 feet (NAVD88). **Figure 1** shows the elevations relevant to this analysis.

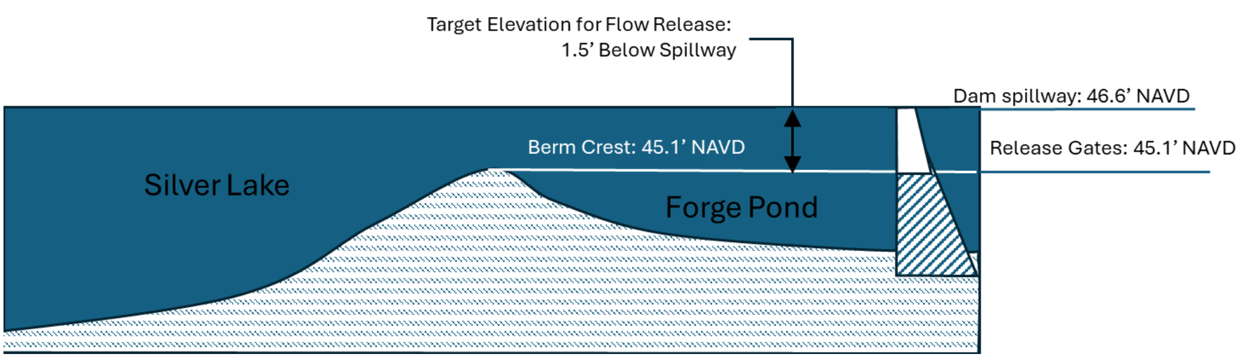

Figure 1 Diagram showing Relevant Elevations for this Analysis (not to scale) (Dawood 2024)

The methodology for estimating the potential days for which there is an opportunity for water release downstream for these different scenarios included three major steps:

1. Development of a stage- storage relationship for Silver Lake
2. Calculation of approximate changes to water surface elevations in Silver Lake for the different scenarios, compared with historical water elevations
3. Understanding the important seasonal periods when downstream flow is critical for diadromous fish populations

Stage Storage Relationship

For the development of the stage-storage curve for Silver Lake, the digitized Coler and Colantonio bathymetric contours from 2003 were used. For each contour elevation, the area was calculated using geospatial analysis in ArcGIS Pro. The volume of each layer was approximated assuming that each layer had the volume of a section of a cone, also known as a frustrum, using the following equation. **Figure 2** is a diagram showing a frustrum with the different elements used in the volume calculation.

$$Volume = \left(\frac{1}{3}\right) \times \pi \times depth \times (R^2 + (R \times r) + r^2)$$

$$where\ R\ is\ the\ radius\ of\ the\ top\ contour,$$

$$r\ is\ the\ radius\ of\ the\ bottom\ contour,$$

$$and\ depth\ is\ the\ difference\ in\ elevation\ between\ the\ two\ contours$$

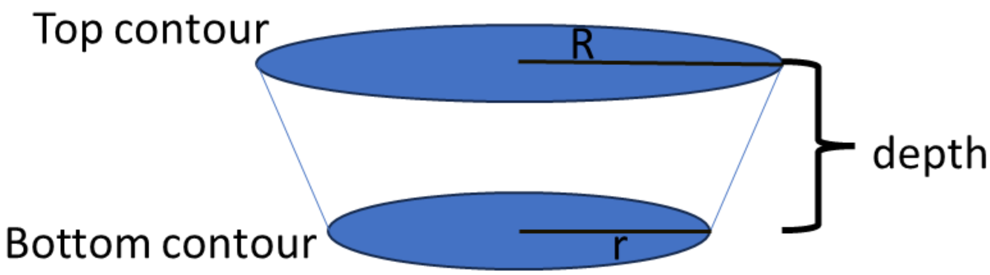

Figure 2 Diagram of a Frustrum

Using these volumes, the stage-storage relationship was developed, as shown in Figure 3. It should be noted that this stage-storage relationship focuses on the top 15 feet of elevation, as this top layer of Silver Lake is the most critical for this analysis. This is an appropriate depth for the stage-storage relationship to be developed for this analysis, as the depth of usable storage within Silver Lake was previously determined to be 11 feet (CDM Smith, 2007). The fitted equation to this stage-storage relationship is used to convert between water storage volume and water surface elevations (and vice versa).

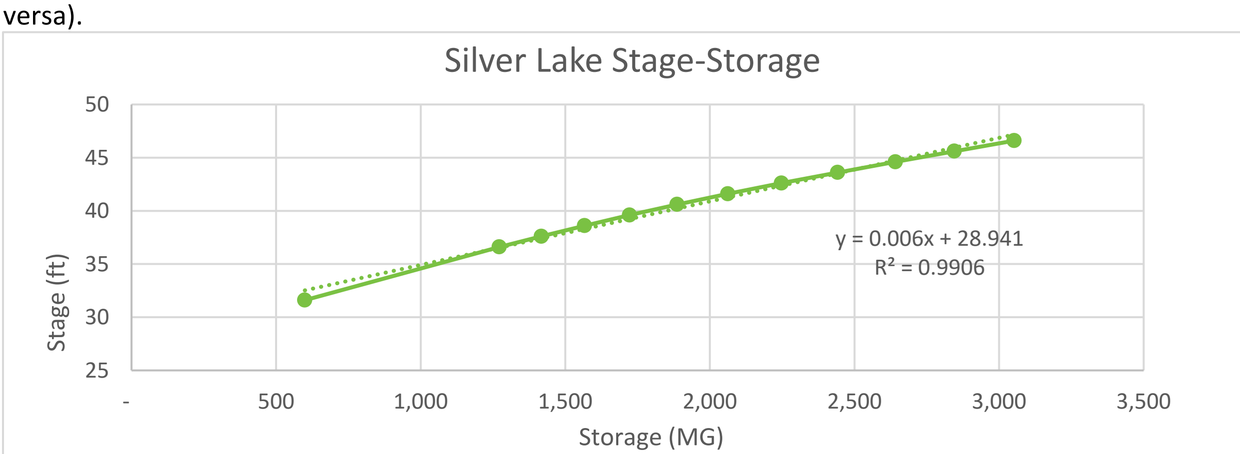

Figure 3 Stage Storage Relationship for Silver Lake

Note: this relationship is developed only for the top 15 feet of Silver Lake as this is the most critical volume for this analysis. The vertical datum is NAVD88.

Changes to Water Height in Silver Lake

To understand the benefit of the additional flow retained in Silver Lake due to Brockton's potential additional use of desalination water, the following steps were used for the period 10/01/1996 to 12/31/2024 for which water surface level data for Silver Lake was available:

- The historic daily water levels in Silver Lake were converted to storage using the stage-storage relationship.
- The additional storage per day in Silver Lake for each scenario was calculated by comparing historic Aquaria water use data for each day of the analysis. If historically there was no Aquaria use, the daily additional flow rate maintained within Silver Lake was equal to the total amount for each scenario, 1.0, 1.5, and 2.0 MGD. On days when Aquaria water was used, but it was less than the flow rate of the scenario, then the additional flow rate was the difference from the scenario's flow rate and the historic Aquaria use. On days when more water from Aquaria was used than the flow rate of the scenario, there was no additional water retained within Silver Lake, so this flow rate was set to zero. Over time, these changes were accumulated mathematically, except when the lake was historically full, as described below.
- The daily new storage for each scenario was converted to a change in water surface elevation using the stage-storage relationship. To account for the accumulation of this additional water per day, the daily change in depth for each scenario was added to the previous day's water elevation, except for when the elevation was above the spillway crest. For days that the historic water surface elevation was above the spillway elevation of 46.6 feet (NAVD88), the water surface elevation is kept the same as the historical value, as no additional water surface elevation will be achieved once Silver Lake is full.

This analysis assumes that the daily water level data provided for Silver Lake is measured in depth below zero, where zero is the Forge Pond Dam spillway crest of 46.6 feet (NAVD88). This point was surveyed as part of this work, on December 13, 2024. It is important to note that this analysis does not account for the drawdown in water surface elevation associated with operational water release from Silver Lake, but instead focuses on the number of days for which there could have been an opportunity to release water from Silver Lake, compared with historical opportunities. More detailed hydraulic and operational modelling should be considered to inform specific operational decisions for managing water release from Forge Pond Dam and its impacts to downstream flow and lake elevations.

Seasonal Periods Critical for Diadromous Fish Populations

Silver Lake is an important habitat for diadromous fish populations such as river herring and blueback herring. The Massachusetts Department of Marine Fisheries uses the following dates for river herring migrations:

- April 1st to June 15th is spawning for alewife herring
- April 1st to June 30th is spawning for blueback herring
- September 1st to November 15th is juvenile emigration for both species

When the elevations of Silver Lake are below the release gate invert of 45.1 feet NAVD88 during the emigration period, juvenile fish cannot leave Silver Lake. A potential practical goal for supporting fish populations would be improving outflow during the fall emigration period (Chase, 2025). Different statistics such as the number of days for which additional flow could be available (compared with historical availability) for these critical periods of time for diadromous fish populations are included in the results.

Results

Table 2 presents the average days per year when there is the opportunity for water to be released downstream from Silver Lake and Forge Pond for each scenario. These results are not forward looking into future hydrologic scenarios, but simply comparative against historical lake elevations and alterations that could have been realized through the utilization of the desalinated water. The elevation used as reference was 45.1 feet NAVD88, as this is the elevation of both the berm crest separating Silver Lake from Forge Pond and the elevation of the Forge Pond Dam release gates (Dawood 2024).

It can be seen from this summary statistic, that the average days per year where water could be released downstream increases with the desalination plant usage scenarios. Historically, the average days per year was 218, which increases by 21 days under the 1.0 MGD scenario, 40 days under the 1.5 MGD scenario, and 58 days under the 2.0 MGD scenario. This demonstrates that by retaining volume in Silver Lake daily through consistent daily usage of the desalination plant, streamflow continuity downstream increases. While diadromous fish population migration happens within specific seasonal periods, improving stream connectivity can support other aquatic life.

Table 2 Average Days Per Year with Opportunity for Downstream Release of Water for Each Scenario

Scenario	Average Days Per Year Elevation Greater than 45.1 feet (NAVD88)	Average Days Per Year during Fall Emigration Period when Elevation Greater than 45.1 feet (NAVD88)
Historic	218	14
1.0 MGD	239	20
1.5 MGD	258	27
2.0 MGD	276	33

Note: Elevation of 45.1 NAVD88 used for this, as this is the elevation of both the berm in Forge Pond and the elevation of the Forge Pond Dam release gates.

Figure 4 shows the changes to water levels in Silver Lake for the different scenarios in reference to relevant elevations, such as the elevation of the spillway of Forge Pond Dam (46.6 feet) as well as the elevation of the berm at the outlet of Forge Pond (45.1 feet) once water has entered Forge Pond. This elevation of 45.1 feet is also the elevation of the Forge Pond release gates. This figure shows all three scenarios reduce the drawdown of Silver Lake water levels during historically observed drawdown periods, typically during summer and fall months. An example of the benefit that the scenarios could provide to downstream flow can be observed by looking at 2002. For this entire year, the water surface elevation was below the elevation needed to discharge downstream. For the 2.0 MGD scenario, the updated water surface elevation would be able to flow downstream for approximately 50% of the year, including most of the fall period that is critical to diadromous fish population emigration. The benefit can be seen throughout the figure, with lower drawdowns in the summer. Plymouth County has experience historic droughts, with more recent significant droughts occurring in 2016-2017 and 2020-2021 (NOAA, 2025). This time series captures these historic droughts and dry periods, as shown by the lows in water levels in 2017 and 2021.

Figure 5 uses the same data presented in **Figure 4**, but focuses more closely on the changes in water level conditions for the different scenarios for the fall migratory period diadromous fish populations, that spans from September 1st to November 15th. This bar chart shows the number of days in this time span for each scenario when the water surface elevation of Silver Lake is greater than or equal to 45.1 feet. For years with no vertical bar for the "Historic" scenario, the water surface elevation did not exceed this elevation. Historically there were 10 years with days during this period that exceeded this elevation, while it increases to 16 years for 1.0 MGD scenario, 17 years for the 1.5 MGD scenario, and 18 years for the 2.0 MGD. This demonstrates the potential for an increase in the potential number of years where downstream flow could have been possible during the fall critical period for diadromous fish populations.

A figure was not prepared for the spring migratory period for diadromous fish populations, as the historical trends showed that water was greater than or equal to 45.1 feet for all but one year.

Figure 6 uses the results from **Figure 5** to calculate how many of the days with flow during the critical period for the Fall emigration of diadromous fish populations are consecutive. Comparing **Figure 6** and **Figure 5,** the values are very similar, indicating that most of the days with the opportunity for flow are consecutive. The largest difference is four days for the 1.0 MGD Scenario in 2006.

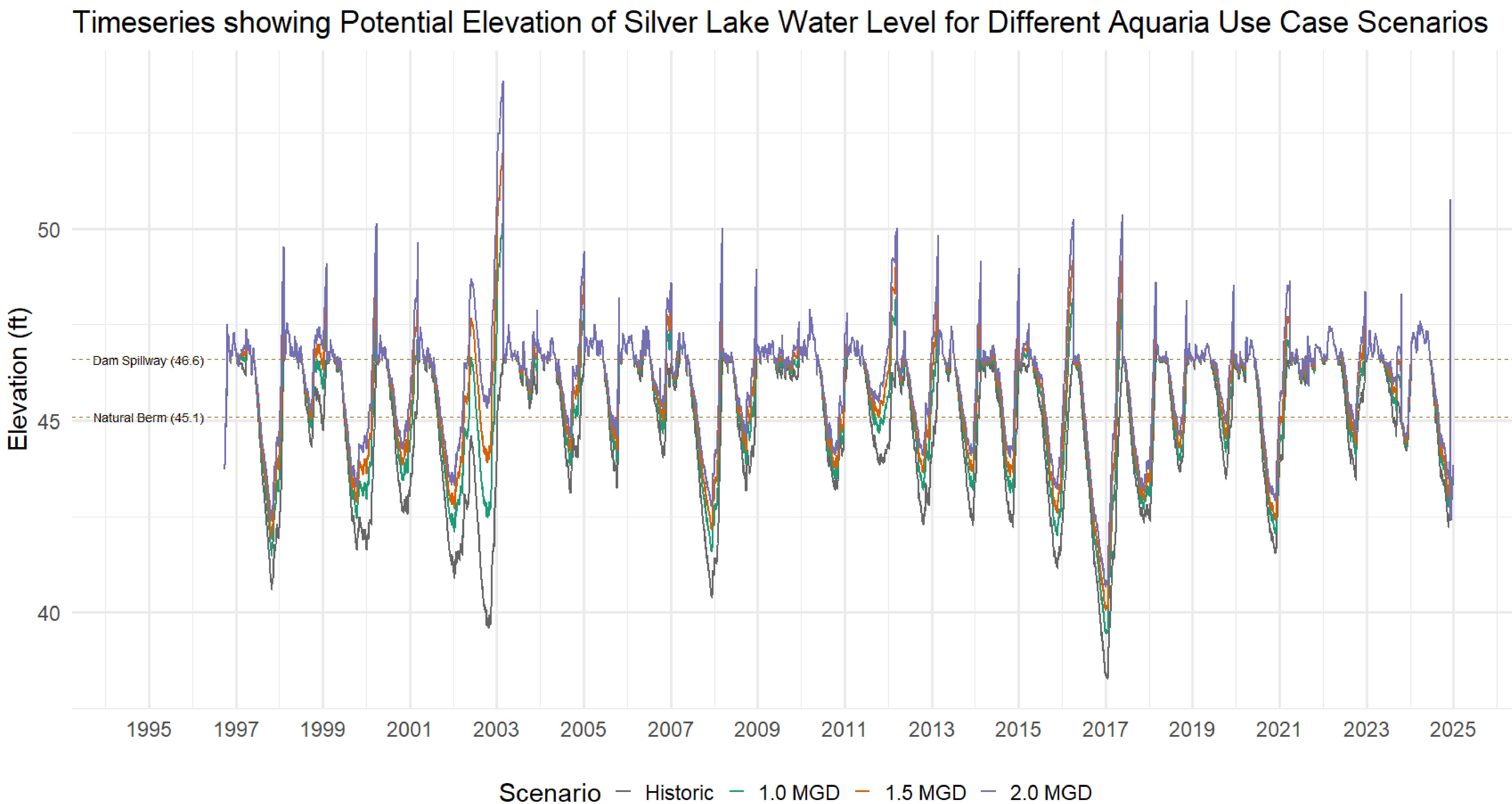

Figure 4 Comparison of Aquaria Scenarios Water Surface Levels to Observed Water Surface Levels

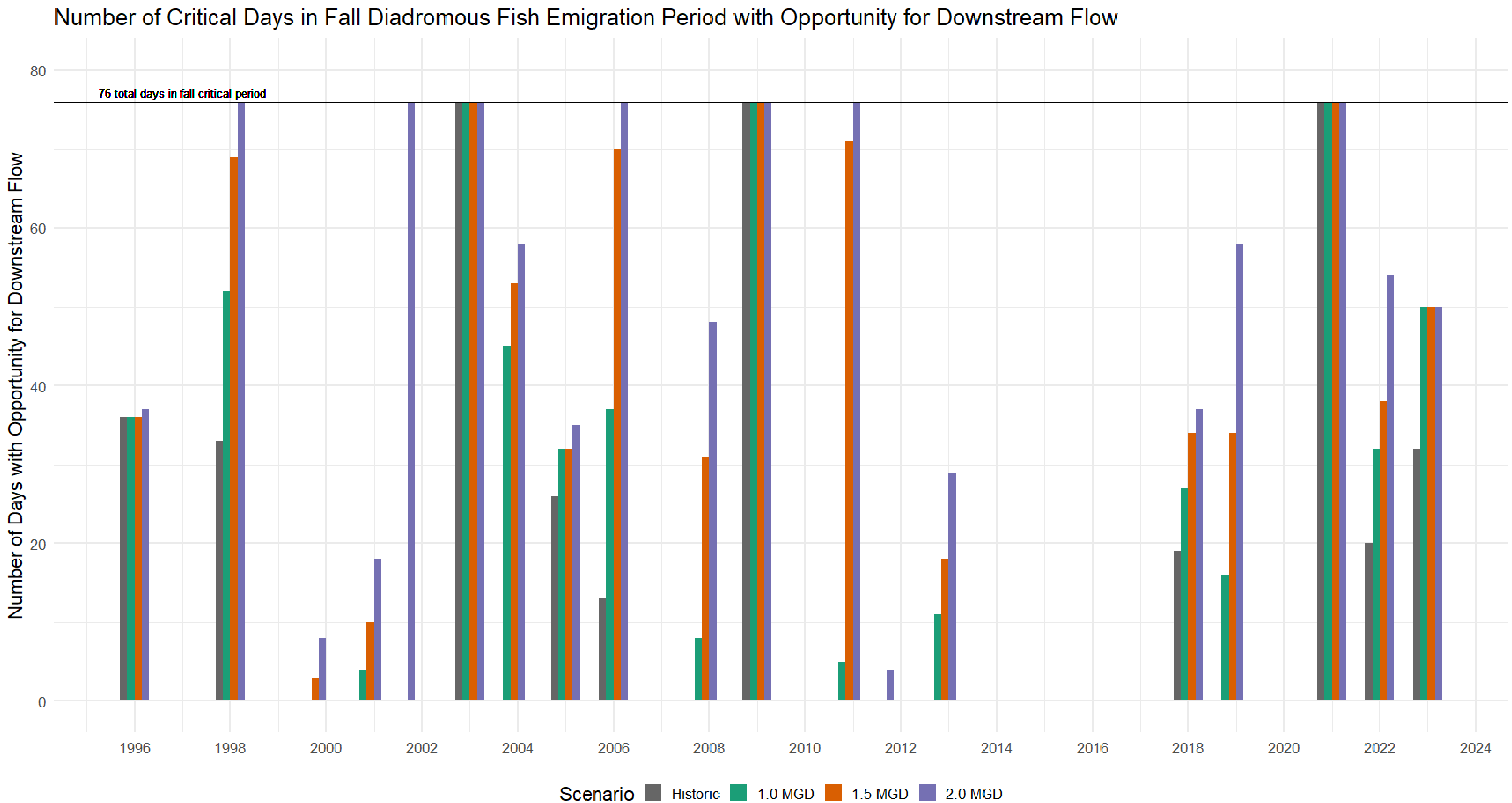

Figure 5 Number of Critical Days in Fall Diadromous Fish Emigration Period (September 1st – November 15th) with Opportunity for Downstream Flow Per Year

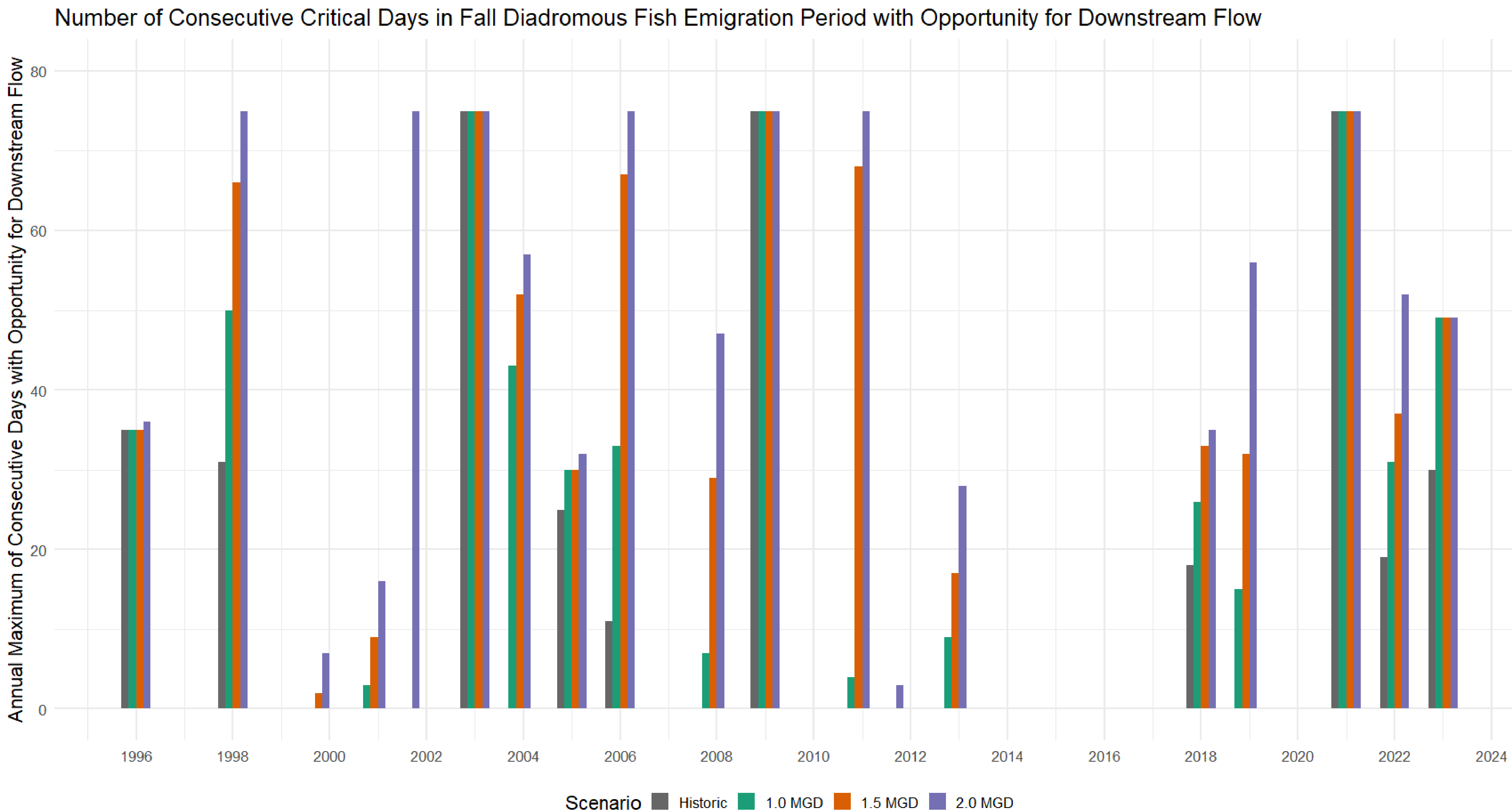

Figure 6 Number of *Consecutive* Critical Days in Fall Diadromous Fish Emigration Period (September 1st – November 15th) with Opportunity for Downstream Flow Per Year

Conclusions

This analysis was conducted to support the OCPC Regional Water Plan in understanding the potential regional benefit of Brockton increasing use of Aquaria desalination water to be able to reduce daily withdrawals from Silver Lake. The results demonstrate that there is value when considering the total number of days where water could flow downstream, as well as increased opportunity for downstream flow during the fall critical period of emigration for diadromous fish. However, this historical analysis does not account for the potential changes to future drought in the area, which may affect the availability of water for flow downstream. It is also important to note that this analysis does not account for the drawdown in water surface elevation associated with water release from Silver Lake, but instead focuses on the number of days for which there is an opportunity to release water from Silver Lake. Likewise, the analysis does not recommend a specific flow rate for downstream release. More detailed hydraulic modelling should be considered to inform specific operational decisions for managing water release from Forge Pond Dam.

While this analysis highlights the benefit in terms of water quantity to Silver Lake, it should be noted that this study did not assess impacts of water quality. The results assume no change in Monponsett inflows even if elevation triggers might have happened less frequently. Further analysis could support understanding the water quality dynamics between Silver Lake and Monponsett Pond for different management scenarios. Another caveat of this analysis is that while it seeks to demonstrate the benefit of Brockton utilizing larger flow rates of water from the Aquaria desalination plant to offset water withdrawn from Silver Lake, it could negatively impact Brockton's registered allowance from Silver Lake.

Some recommendations for next steps include:

- Development of a model of Silver Lake and its connected water bodies. This model could integrate water quality, hydraulic elements related to the operation of Forge Pond Dam, the connection with Monponsett Pond, and future conditions of precipitation and droughts.
- Coordination with Department of Marine Fisheries to understand specifics for number of consecutive days, flow depths and velocities that would best support upstream fish passage, and development of corresponding scenarios in the hydrologic model.
- Using the model, identification of the best operational practices that would enable Brockton to continue to take water from the lake while preserving water quality and quantity for fish passage.

Increasing use of the Aquaria desalination water plant is an important solution identified in the Regional Water Plan, to support a resilient and clean water supply for the region. This analysis demonstrates that this solution could also support improvement of ecological conditions by increasing the opportunity for days with downstream flow from Silver Lake to support aquatic life such as diadromous fish populations.

References

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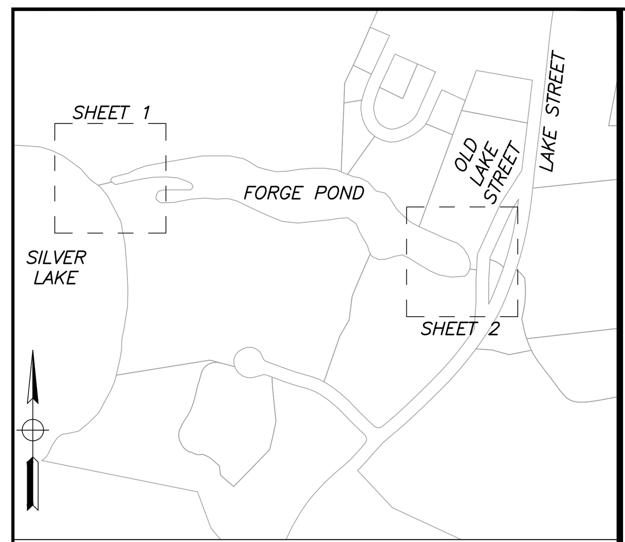
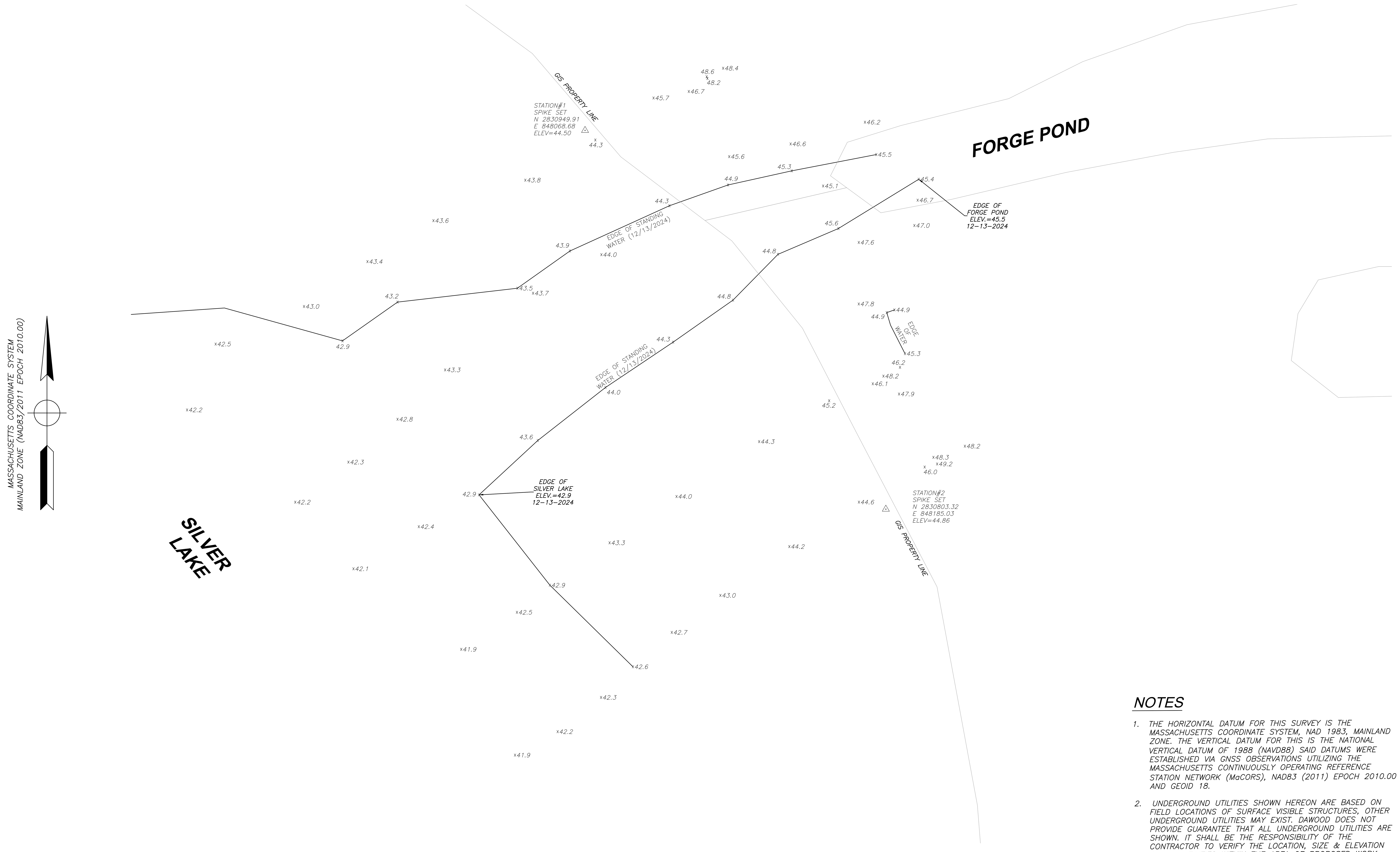
Appendix A
Existing Conditions Survey: Dam at Silver Lake



LOCUS MAP:
NOT TO SCALE



NOTES

1. THE HORIZONTAL DATUM FOR THIS SURVEY IS THE MASSACHUSETTS COORDINATE SYSTEM, NAD 1983, MAINLAND ZONE. THE VERTICAL DATUM FOR THIS IS THE NATIONAL VERTICAL DATUM OF 1988 (NAVD88) SAID DATUMS WERE ESTABLISHED VIA GNSS OBSERVATIONS UTILIZING THE MASSACHUSETTS CONTINUOUSLY OPERATING REFERENCE STATION NETWORK (MaCORS), NAD83 (2011) EPOCH 2010.00 AND GEOID 18.
2. UNDERGROUND UTILITIES SHOWN HEREON ARE BASED ON FIELD LOCATIONS OF SURFACE VISIBLE STRUCTURES, OTHER UNDERGROUND UTILITIES MAY EXIST. DAWOOD DOES NOT PROVIDE GUARANTEE THAT ALL UNDERGROUND UTILITIES ARE SHOWN. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE LOCATION, SIZE & ELEVATION OF ALL UTILITIES WITHIN THE AREA OF PROPOSED WORK AND TO CONTACT "DIG-SAFE" AT 811 AT LEAST 72 HOURS PRIOR TO ANY EXCAVATION, DEMOLITION OR CONSTRUCTION.
3. THIS PLAN IS A RESULT OF AN ON-THE-GROUND SURVEY COMPLETED ON DECEMBER 13, 2024.
4. PROPERTY LINES ARE BASED ON GIS DATA OBTAINED FROM MASSGIS.

ABBREVIATIONS

BCD	BITUMINOUS CONCRETE DRIVE	GP	GUARD POST
BCW	BITUMINOUS CONCRETE WALK	GRAIL	GUARD RAIL
BLDG	BUILDING	HH	HANDHOLE
CB	CATCH BASIN	LP	LAMP
CBDH	CONCRETE BOUND WITH DRILL HOLE	(M)	MARKED
CLF	CHAIN LINK FENCE	MAG	MAGENITIC
COBBSTN	COBBLE STONE	MBTA	MASS. BAY TRANS AUTHORITY
CONC	CONCRETE	MH	MANHOLE
CP	CONCRETE POST	MWRA	MASS. WATER RESOURCE AUTHORITY
CU	CONNECTION UNKNOWN	N/F	NOW OR FORMERLY
CW	CONCRETE WALK	NPV	NO PIPE VISIBLE
DH	DRILL HOLE	(R)	RECORD
DI	DUCTILE IRON	RCP	REINFORCED CONCRETE PIPE
DMH	DRAIN MANHOLE	RET.	RETAINING
DWS	DETECTABLE WARNING STRIP	RR	RAILROAD
DYLL	DOUBLE YELLOW LANE LINE	SB/DH	STONE BOUND/DRILL HOLE
E	EASTING	SMH	SEWER MANHOLE
ELEV	ELEVATION	STN	STONE
EM	ELECTRIC METER	SWLL	SINGLE WHITE LANE
EMH	ELECTRIC MANHOLE	TMH	TELEPHONE MANHOLE
EOP	EDGE OF PAVEMENT	TOH	TOP OF HOOD
FNC	FENCE	TOW	TOP OF WATER
FND	FOUND	TSCC	TRAFFIC SIGNAL CONTROL CABINET
GC	GRANITE CURB	UP	UTILITY POLE
GG	GAS GATE	WF	WETLAND FLAG

SYMBOLS

BENCHMARK
BUSH
CB CATCHBASIN
ELECTRIC MANHOLE
DECIDUOUS TREE
DRAIN MANHOLE
EVERGREEN TREE
HYDRANT
LAMP POST
DOUBLE POST SIGN
SINGLE POST SIGN
x101.00 SPOT ELEVATION
TRAVERSE POINT

0 20 50 100
SCALE: 1" = 20'

LINEWORK

BRUSH LINE
CHAIN LINK FENCE
101.12 / 101.75 CURB WITH TOP AND BOTTOM ELEVATIONS
D DRAIN LINE
STEEL GUARD RAIL
E ELECTRIC LINE
100 MAJOR CONTOUR
101 MINOR CONTOUR
PROPERTY LINE
RIGHT OF WAY LINE
TELEPHONE LINE
TOWN/CITY LINE
TREE LINE
W WATER LINE
WOOD FENCE LINE

DRAFT

MARK R. MAGOWAN
MASSACHUSETTS REGISTERED PROFESSIONAL
LAND SURVEYOR NO. 35038

DATE

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325 Wood Road
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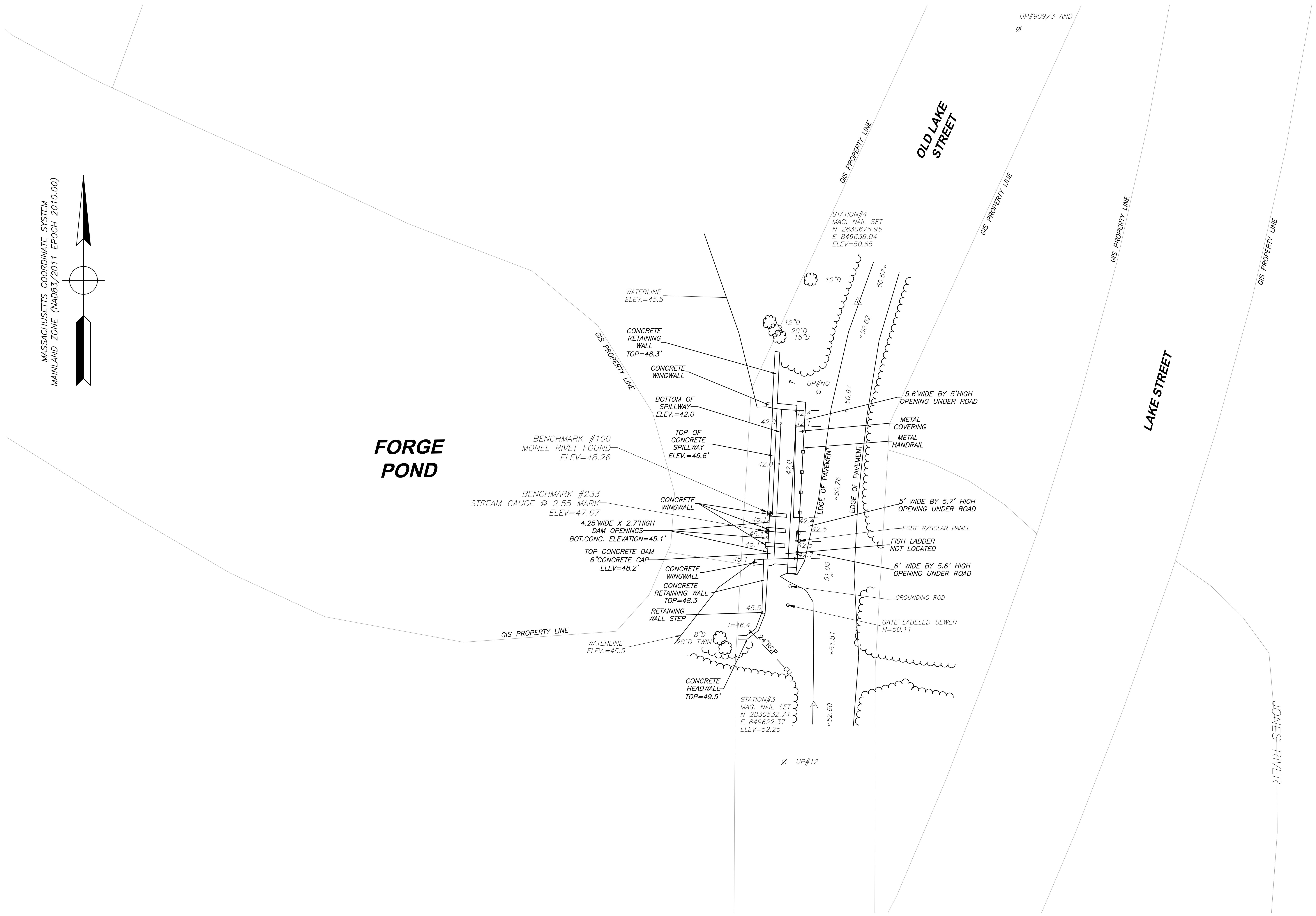
Braintree, MA 02184
t: 781.380.7766
f: 781.380.7757

REVISIONS				
NO.	DATE	DESCRIPTION	CHECKED	DRAWN

EXISTING CONDITIONS SURVEY
DAM AT SILVER LAKE
LAKE STREET
KINGSTON, MASSACHUSETTS

PLAN PREPARED FOR:
CDM SMITH
3 DAVOL SQUARE,
BUILDING A,
SUITE A-425,
PROVIDENCE, RI 02903

DATE	JANUARY 8, 2025
JOB NO.	2400396.00
FILE NAME	2400396.00WS C3D2021.DWG
DRAWN BY	EP/GR
CHECKED BY	MRM
SHEET NO.	1 OF 2



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SYMBOLS

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CB CATCHBASIN	TRAVERSE POINT
ELECTRIC MANHOLE	
DECIDUOUS TREE	
DRAIN MANHOLE	
EVERGREEN TREE	
HYDRANT	
LAMP POST	
DOUBLE POST SIGN	

0 20 50 100

SCALE: 1" = 20'

LINEWORK

- BRUSH LINE
- CHAIN LINK FENCE
- CURB WITH TOP AND BOTTOM ELEVATIONS (101.17 / 101.75)
- DRAIN LINE (D)
- STEEL GUARD RAIL
- ELECTRIC LINE (E)
- MAJOR CONTOUR (100)
- MINOR CONTOUR (101)
- PROPERTY LINE
- RIGHT OF WAY LINE
- TELEPHONE LINE
- TOWN/CITY LINE
- TREE LINE
- WATER LINE (W)
- WOOD FENCE LINE

DRAFT

MARK R. MAGOWAN
MASSACHUSETTS REGISTERED PROFESSIONAL
LAND SURVEYOR NO. 35038

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f: 781.380.7757

REVISIONS				
NO.	DATE	DESCRIPTION	CHECKED	DRAWN

EXISTING CONDITIONS SURVEY DAM AT SILVER LAKE

LAKE STREET

KINGSTON, MASSACHUSETTS

PLAN PREPARED FOR:
CDM SMITH
3 DAVOL SQUARE,
BUILDING A,
SUITE A-425,
PROVIDENCE, RI 02903

DATE	JANUARY 8, 2025
JOB NO.	2400396.00
FILE NAME	240039600WS C3D2021.DWG
DRAWN BY	EP/GR
CHECKED BY	MRM
SHEET NO.	2 OF 2


PREPARED BY
CDM Smith